metal finishing

PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, METAL SPRAYING and all METAL FINISHING PROCESSES

Vol. 7 No. 83 (New Series) NOVEMBER, 1961

EFFECTIVE PFIZER CHEMICALS FOR METAL FINISHING

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DE-RUSTING

METAL CLEANING

METAL DEGREASING

ALUMINIUM COLOURING

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A preferred ingredient in electroless nickel baths, resulting in a brighter plate. Also finds wide use in electroplating processes.

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Especially useful for the removal of rust in near neutral solutions.
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Excellent complexing agent for copper in electroplating.

Tartar Emetic . . .
Used in electrolytic baths for deposition of silver and antimony alloys on brass, copper and steel surfaces.

	Cleaning	Polishing	Pickling	Electro-plating	Electro-polishing	Non-electrolytic depositions	Electrolytic oxidation	Etching	Aids colouring of aluminium
Citric Acid	✓		✓	✓		✓		✓	
Sodium Citrate	✓			✓		✓			
Ammonium Citrate	✓		✓						
Gluconic Acid	✓	✓	✓	✓					
Glucono-Delta-Lactone			✓						
Sodium Gluconate	✓	✓							
Ammonium Oxalate		✓							
Ferric Ammonium Oxalate									✓
Tartaric Acid	✓		✓	✓				✓	
Tartar Emetic				✓					
Rochelle Salt			✓						
Cream of Tartar	✓			✓					

Rochelle Salt . . .
Increases efficiency and yields a finer-grain deposit in alkaline copper plating.

Cream of Tartar . . .
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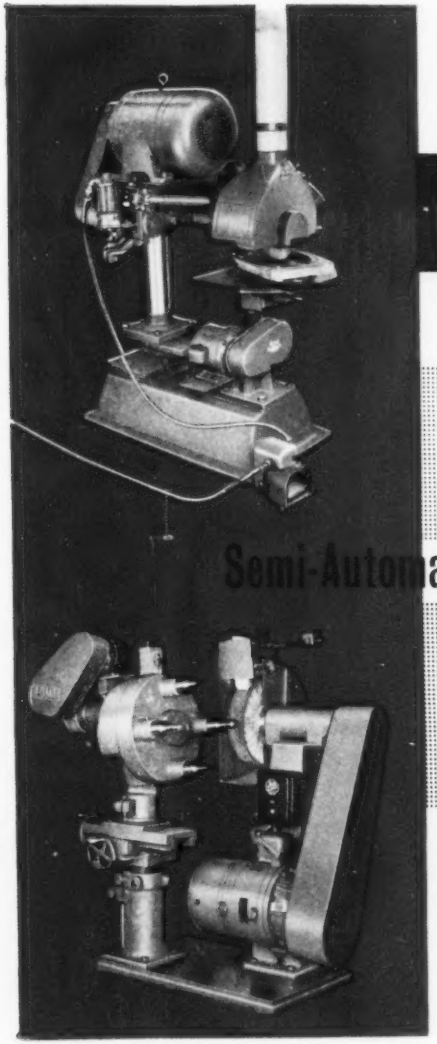

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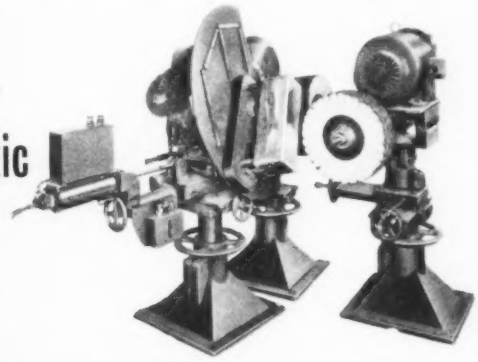

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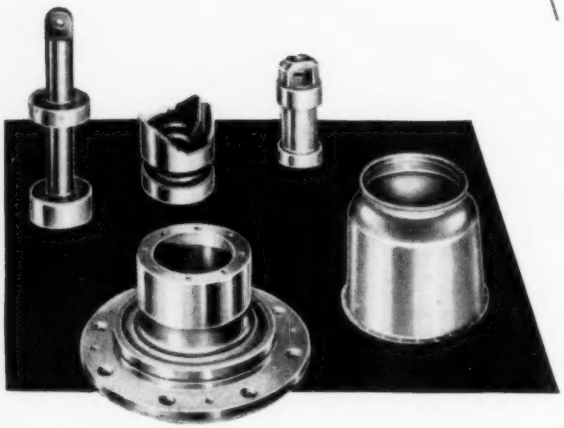

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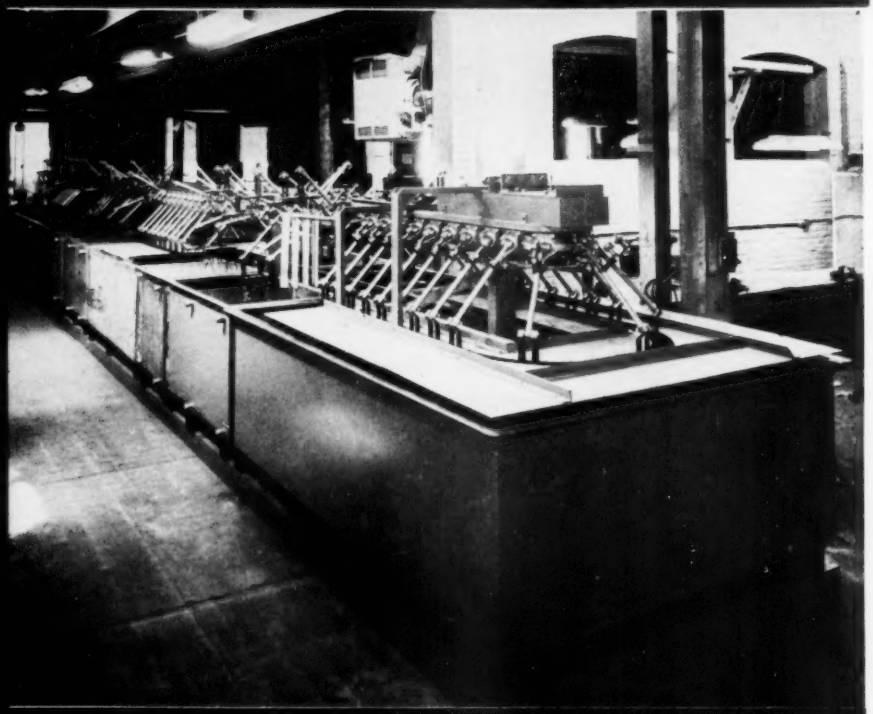

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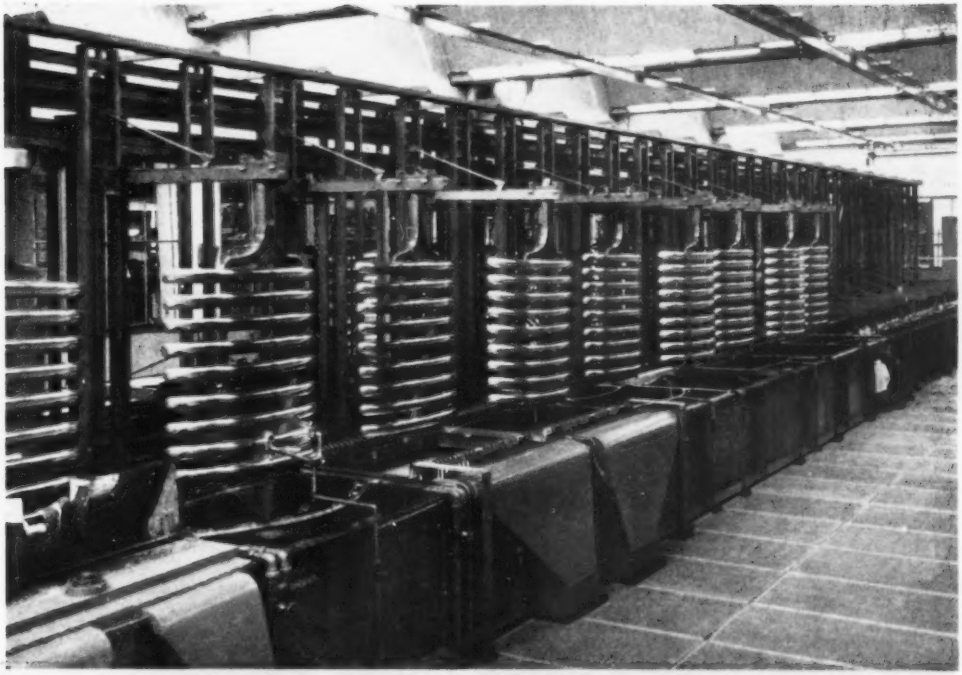

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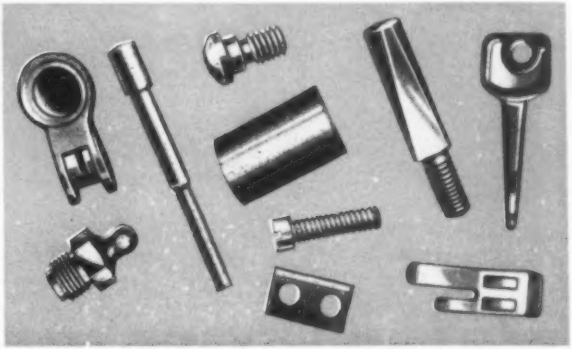

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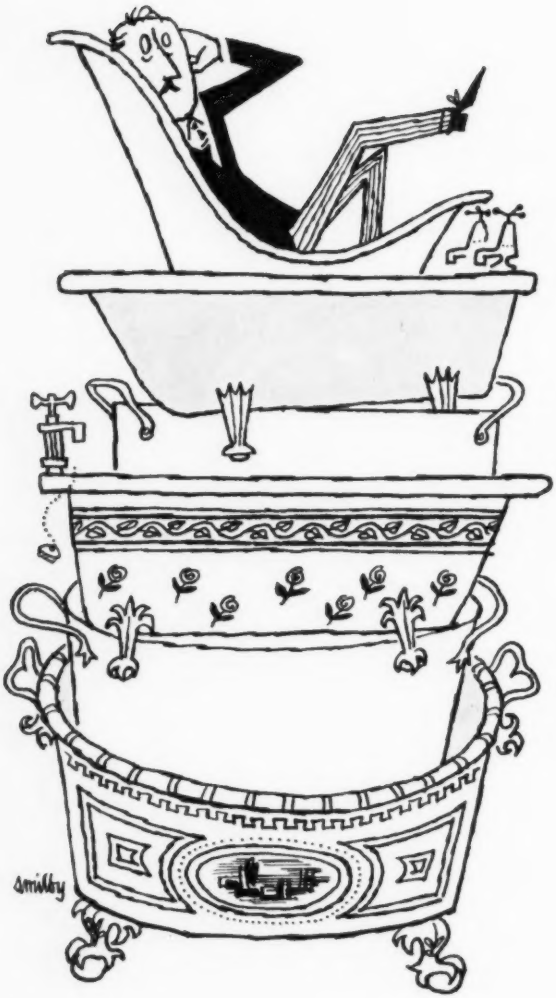

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Illustration : Six-stage cleaning and phosphating unit with dip painting equipment for motor panels.

STORDY ENGINEERING LIMITED

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metal finishing journal

November, 1961 — AN INDUSTRIAL NEWSPAPERS PUBLICATION — Vol. 7, No. 83 (New Series)

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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

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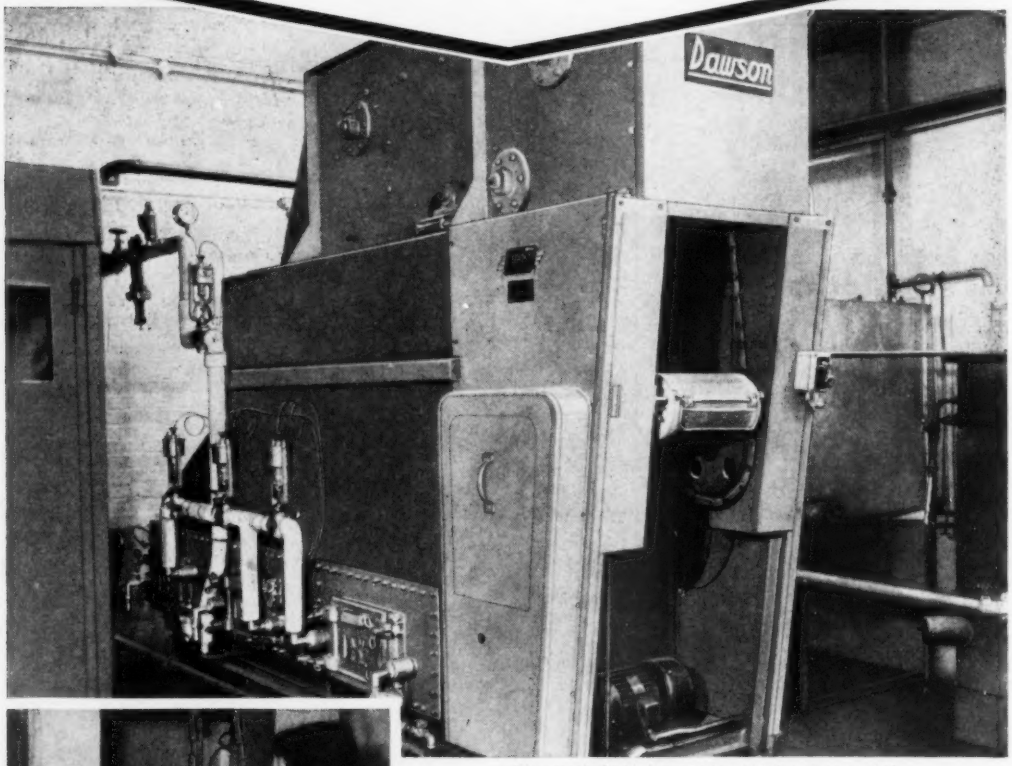

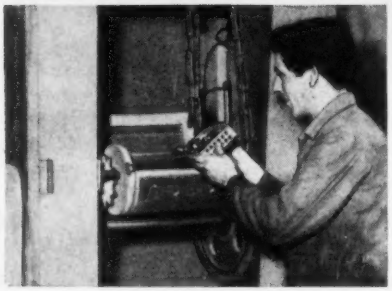

The Operator is seen loading the battery cases into one of the rotating baskets attached to the continuous conveyor of the machine.

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QUOTE OF THE MONTH

THOSE of us who study the sections of the national and technical press devoted to recording the more noteworthy sayings of persons of eminence speaking on public occasions, will have noticed a greatly increasing critical attitude towards the bulk of British industry and its lack of initiative and progressive thought. Some of these comments have been particularly outspoken, as for example the widely quoted view of Mr. S. P. Chambers, chairman of Imperial Chemical Industries Ltd., who, in the course of an address to the Institute of Personnel Management said that " for too long sections of British industry have been becoming increasingly insular, introspective, reactionary and inflexible . . . sections of industry, which are obsolete and inefficient ought to be shut down . . .". While on another occasion Lord Hailsham, Minister for Science, is reported as saying that " far too few scientists are employed in industry and if more were employed some directors might not—in their present frame of mind—know what use to make of them ".

These are heavy indictments made by men whose standing and position cannot be expected to lend itself to the expression of ill-considered opinions, nor are they solitary voices which can be dismissed as the mouthings of doctrinaire fanatics. Similar views have been expressed with equal force from other equally influential quarters in recent weeks.

In view of this critical Rhodomontade it is proper for us to consider to what extent the strictures are applicable to the finishing industry and how far action is being taken to remedy the state of affairs which has evoked them.

Although there are bright spots the picture is far from being wholly encouraging. For example, one can look around and see, with perhaps a feeling of misguided satisfaction, that the use of automatic plating plant is increasing in firms both large and small, but how many consider whether this type of plant is being used effectively ? How much time is being wasted on wiring-up and jigging ? Is proper attention being paid to handling of work in plating, enamelling, painting and galvanizing shops ? Automatic or mechanized equipment, which is costly to install, can only be fully economic if all ancillary stages are operated at maximum efficiency.

A further point worthy of consideration is how much greater efficiency and productivity can be obtained by jobbing finishers specializing more on one type of product ? By adopting this attitude equipment designed specifically for the job could be used with the attendant obvious advantages.

Difficulties there may be in furthering this suggestion, but it should not be impossible for a number of firms, perhaps in a given area, to agree to exchange work on this basis in the interests of overall efficiency. The net result could be a " gain " for the industry as a whole, the firms themselves, and most of all for the customer. He it is who furnishes the reason for any firm doing anything, and providing him with an improved product and improved service should always be the primary consideration.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

ITALY TAKES THE LEAD

IT is rather appropriate that the first steps towards the unification of metal finishing standards should have been taken during the Centenary celebrations of the Unification of Italy in Turin. The symposium held there last month and attended by over 100 people (including 16 from the United Kingdom) showed more than anything else that there is a quite astounding degree of divergence of opinion on metal finishing specifications. Not only do existing and proposed national standards differ widely but, to add to the confusion, there are quite a number of private specifications in operation. These are mainly issued by motor manufacturers in different parts of the world who endeavour to impose them on their suppliers.

Taking only the national specifications, an interesting comparison was produced by the B.S.I. which showed that for the highest quality nickel-chromium plating, the standards ranged from a minimum direct nickel thickness of 50μ in France and Italy down to 12μ in Germany and Yugoslavia whilst medium quality standards likewise lay between 25μ and 6μ.

There were other widespread divergences in testing procedures and opinions. One standard (Switzerland) is unique in that it includes *maximum* thickness figures. Obviously some sorting out is long overdue and the fact that Italy has applied to the International Standards Organization for the Secretariat of a new Standards Committee to do this is most commendable.

The meeting by all accounts was admirably organized and included a simultaneous translation service and the pre-printing in English of most of the papers presented. If the Secretariat does go to Italy, it looks as though it will be in very capable hands.

BARRIER TO CORROSION

THE use of many plastics for outdoor exposure over a long period has in the past been limited by considerable doubts regarding their durability. Loss of surface finish and crazing have been the main problems, so that large scale experience of their use has been somewhat restricted. This applies especially where appearance is important, although there are some architectural installations of plastic panels.

Those interested will therefore be able to study conveniently a large scale test in the form of a p.v.c. coated steel fence which has been erected around the premises of Technicolor Ltd. near London Airport. It adjoins the footpath so that any passer-by who is seen peering at it closely will be readily identifiable as either a plastics technologist or a corrosion engineer.

A possible danger with this type of thick plastic coating is that progressive attack could take place beneath it through breaks which might develop for one reason or another. This would not become apparent to the observer until the metal had been badly eroded and the structure weakened, whilst the coating remained apparently sound. Whether this is a serious hazard remains to be seen.

MORE PLASTICS

WHILST on the subject of plastics, it has been reported that at least one motor manufacturing company is interested in the possibility of using injection moulded body skin panels made of nylon in place of steel for certain areas such as bonnets and boot covers. These would have the advantage that fittings, bosses, etc. could be moulded in, thus effecting savings in cost.

Moreover, the colour could also be incorporated in the moulding, although here there might be a problem in matching with the rest of the paintwork, so that in all probability the moulding would have to be painted conventionally. At present the cost is higher than steel, but the price may well be substantially reduced in the future.

For some time past, plastic reinforced glass fibre was the only serious potential competitor to steel for automobile bodies, but this development shows that there may be other possible rivals in the offing.

UNGILDING THE LILY

ONE of the objections to stainless steel for outdoor use is the fact that on exposure it tends to lose its lustre and becomes a dingy grey colour.

We therefore read with some puzzlement a paper in a recent issue of "Galvanotechnik" describing a new process for the treatment of stainless steel. It consists of first pickling it in hydrochloric acid, then dipping into a solution of ferric chloride in the same acid, and finally treating in an arsenic bath. After all this trial and tribulation a strongly adherent grey film is said to be obtained on the stainless steel.

Maybe it takes a little longer to just let it happen —but it is much cheaper. Perhaps there is a good use for a process like this if I could only think of it!

A Report of the

INTERNATIONAL CONFERENCE ON THE SURFACE TREATMENT OF ALUMINIUN-MILAN OCT. 1961

THIS conference was conveniently arranged prior to another international symposium on the standardization of surface finishing, held in Turin from October 10 to 12. As the organizers obviously realized, many people from abroad availed themselves of attending both symposia.

Unlike the Institute of Metal Finishing Conferences, this conference was unique in two ways—one, that it was entirely concerned with surface finishing of aluminium, and two, it was held during a weekend. The latter scheme of course allowed many people to attend who would not normally have done so.

On arrival, the delegates were taken on rather a haphazard tour of a large new Italian architectural anodizing plant, which was in course of construction on the outskirts of Milan. The plant, being built by the CITAN Anodizing Co., was considered to be the finest in Europe by the proprietors of the company. The tanks were of a colossal size, measuring about 30 ft. long, 12 ft. deep and 4 ft. wide, and also shaped as to be wider and deeper at ends and middle respectively, so that large welded frames and other structures could be immersed *in situ*. The plant, which was to cost about £75,000 when complete, was being installed and supplied almost entirely by Italian finishing houses and engineers ; it was built on the conventional style of automatic anodizing plants, namely with the tanks disposed horizontally lengthways on, and with overhead cranes to carry the work. Several different colours, apart from the conventional gold and black, were to be offered, and it was understood that sealing was to be executed in nickel acetate or nickel sulphate solution rather than boiling water, for the majority of the work.

At the end of the large airy anodizing shop, a smaller plant, built round 12 to 15 ft. x 6 ft. deep x 3 or 4 ft. wide tanks, was to cope with the demands of bright anodizing. If any particular brightener had been decided upon, it was not divulged.

The polishing, burnishing and pre-mechanical treatment-shop covered a considerable area and incorporated large manually operated and automatic polishing machines. In particular one large machine was capable of semi-automatically polishing extrusions of different profiles, and another, of polishing large sheets up to 16 ft. x 4 ft. or so in dimensions. Another machine linished sheets of much the same size, automatically. The fine degree of uniformity which can be achieved with these machines particularly with the linisher, is claimed to be second to none.

First Technical Session

On Saturday, the real business of the conference began in the form of the first technical session. Four papers were presented :—

(1) "Some Electrical Properties of the System Al/Al_2O_3 Solid Conductor" by O. Korelic, B. Lovrecek, T. Nikolic, and V. Puskaric Sinovcevic (Institute of Metal Studies, Zagreb).

(2) "Formation of Alpha-Alumina (Corundum) Films on Aluminium by Anodic Oxidation in Fused Salt-Systems" by S. Tajima, T. Mori and M. Shimura (University of Tokio).

(3) "Some Considerations in the Etching of Aluminium" by R. E. Petit, Diversey Co., Chicago.

(4) "Properties of Sulphuric-acid Anodic Films Obtained in Various Conditions" by A. Prati, F. Sacchi and G. Paolini (ISML-Milan-Novara).

The first paper discussed in some detail was the electrical rectification effect observed by various workers in different countries for many years. The authors first considered an anodic film, produced in an electrolyte, as consisting of three phases separated by two distinct junctions, *i.e.* Al/Al_2O_3/electrolyte. They pointed out, however, that such a structure, assuming complete homogeniety within the oxide layer could not account for it's intrinsic electrical properties, and so they investigated a system where the electrolyte was replaced by an electronic conductor. Barrier layers were produced in an ammonium tartrate electrolyte at *p*H 5.8 and an applied voltage between

150 or 200. The barrier-layer coated metal was put between steel blocks with the oxidized layer next to an electronic conductor (Al. or plastic graphite) and a small voltage applied to the system under a constant load. The current flowing in both a +ve and −ve direction was measured, and was found to be large when the aluminium electronic conductor was +ve up to a critical voltage, but only very small when the conductor was −ve.

The fact that the current was large only up to a certain critical voltage was attributed to the fact that the conductivity of an oxide film could be due to both the transport of the current either by Al^{+++}, OH^- or H^+ (protons) within the film and this depends on the voltage applied. Also by use of alternating current measurements, the authors felt that an anodic film was in fact a series of n strata, where each strata was electrically different to the other. They proposed an electrical model for the barrier layer as shown in Fig. 1 and each little circuit x, y, z etc. was frequency dependent. Their paper gave actual measurements of impedance which agreed with actual calculations assuming the proposed model.

Fig. 1.

This was a very interesting paper which did not have any discussion, but merits further study. The difficulty prevalent throughout the whole of this conference was the fact that speakers were allowed to present their papers in full, instead of the ten or so minutes allowed for a summary, which meant that there was little time for discussion.

Prof. Tajima was not present to present his paper, and it was summarized by another speaker. The authors have done some original work using fused salt baths, based on mixtures of potassium and sodium bisulphates, potassium nitrate and nitrite, sodium nitrate and nitrite. The films produced, consist of α alumina resting on a barrier layer. The film is hard and usually rough, whitish or opaque. The pores are large, greater than 1μ and it is considered by the authors that the rate of growth of the film is governed by the transport of Al^{+++} through the lattice of the oxide. The film is free of water, possible applications of this anodising technique was considered by the authors to be:—

(a) as an abrasive, as the rough oxide produced is very hard;
(b) the white colour of the film produced on pure Al and Al-Mg alloys has decorative value (it being difficult or impossible at the present time to produce true white porcelain finishes by anodizing);
(c) as a pre-treatment for painting (porous structure promotes good paint adhesion);
(d) for electrical application, *i.e.* condensers (film is very flexible);
(e) together with a suitable sealing process, for corrosion resistance, and
(f) as thermal insulators.

As a postscript to this it was added that thermal treatment of the coatings produced a good structure on alloys of different composition. Discussion of the paper was not possible in the absence of the authors.

The third, very long paper, was an attempt to put down, in the form of quantitative data, the things everyone knows in practice about sulphuric-acid anodizing.

Two fixed thicknesses of anodic film, 12μ and 26μ were produced in sulphuric acid electrolytes of 12 to 25 per cent W/W H_2SO_4 at temperatures between 18° C. and 25° C. using a current density of 1 to 3 amp. per sq. dm. Properties of the films produced were assessed, these were coating ratio, anodizing voltage, dye absorption, abrasion resistance and corrosion resistance (assessed by immersion in 5 per cent V/V H_2SO_4, N/10 HCl, acetic acid-salt spray, Kesternich spray cabinet and exposure to an industrial atmosphere).

As expected, the hotter the electrolyte, or higher it's concentration, the more porous the film, and hence the lower the coating ratio, and higher the sealing values and dye uptake. (This latter point was confirmed by the authors by photometric measurements). Higher sealing values than those previously reported by Spooner were recorded, and this was attributed to the purer water used for the authors' experiments. The work confirmed recent work published by Alcoa, namely that the hotter the electrolyte the more the reflectivity is maintained at any one film thickness. Abrasion resistance was better for the thinner films, this property being assessed by the abrasive wheel technique. The best method for evaluation of the corrosion resistance was acetic acid-salt spray, the results from which showed an interesting correlation with coating ratio in Figure 24 of the authors' paper, in that at any anodizing time the best corrosion resistance is attained when the coating ratio is between 1.2 and 1.4. It will be interesting to note if the results of the outdoor exposure will indicate the same thing.

Mr. J. M. Kape of Aluminium Laboratories Ltd., Banbury, pointed out that the high corrosion resistance shown by the high-temperature anodic coatings, could be in fact, solely due to the high sealing weight gain over the more conventional coatings. He also queried the ethics of high temperature anodizing from the control point of view, and criticised the softness of the anodic film, particularly where parts so produced were intended for automobile trim.

Mr. Petit's paper was of the rather general nature of which Americans are very fond, namely, telling one an awful lot without giving anything away. Dr. Sacchi presented the paper in Mr. Petit's absence. It dealt with the general methods of anodic oxidation *via* a flow-chart, and stressed the importance of various etching methods in order to produce various surface finishes. Then followed the variation of etching rate given by certain anonymous products on various alloys, and the subsequent methods of removing smut from the surfaces after etching. A more interesting section on the properties of etching smuts, and their removal concluded the paper.

Second Technical Session

The second technical session, during the afternoon was devoted to a further four papers. The first of these was by G. Darnault (Aluminium Français-Paris) entitled "A Contribution to the Study of Quality Control of Sealed Anodic Films." The method used was similar to that reported by M. Richaud at Nottingham University, namely, measurement of the loss in weight of the anodic film, in nitric acid, whence differences are shown up between coatings sealed in various ways. Two different concentrations of nitric acid were used and attempts to categorize, by means of weight loss sealing treatments, from grade 4 (v. good) to 0 (v. bad). Studies were made of the influence of contamination of a sealing bath during use, on the sealing quality obtained, and also on the suitability of various salt sealing solutions. With a 20μ film produced in H_2SO_4, the author concludes that still the best sealing treatment, relative to the nitric acid test, is boiling distilled or demineralized water used for 40 minutes to 1 hour. Nickel sulphate or nickel acetate sealing did not improve to test result.

During the discussion, as expected, Dr. Sacchi (ISML-Novara) questioned the results, as ISML had found that nickel sulphate sealing gave good results, relative to the HNO_3 sealing test. This was resolved after a rapid discussion, by the fact that Darnault had used a far weaker solution than Sacchi. Sacchi also queried the good agreement that Darnault had obtained between his "ink-stain" tests and the HNO_3 test, owing to the anodic film ageing effect, which could mask the test results. The author replied that all his tests had been carried out before 24 hours or so after sealing, and hence felt the ageing effect was not too serious. Richaud recapitulated his paper given at Nottingham University a few weeks ago which was on the same subject as Darnault, but seen from a different viewpoint. The author made little comment.

The next paper, "The Influence of Ageing of Anodic Films on Accelerated Tests" by F. Sacchi, G. Paolini and A. Prati (ISML-Novara) was presented by Dr. Sacchi. Accelerated tests were carried out on 99.5 per cent Al samples with a 12μ anodic film sealed by distilled water, tapwater, $(CH_3COO)_2Ni$, and $NiSO_4$ at 70°C. and 100°C. for 5 to 30 minutes. These coatings were allowed to age for between 2 and 7200 hours and tested at various times using the HCl N/20, H_2SO_4 5 per cent V/V, and Kape SO_2 solution tests ; and the acetic-salt spray, dye absorption drop-test and the breakdown voltage test. The main observation to record as a result of this work is in fact that anodic films do age at a considerable speed, whether they are unsealed, partially sealed or well sealed, and whatever the mechanism of this ageing, it affects the results of sealing tests, some being effected to a greater degree than others. Apparently (and it is important to realize that this is possibly only an "apparent" effect, relative to accelerated tests) the film appears better sealed the longer it ages—this was observed by the authors using all the solution tests, the drop test and the breakdown voltage test. The authors stated that the Kape SO_2 test still retained a good degree of selectivity of sealing treatment even on well aged films, although they were using the solution on a quantitative, weight loss basis, rather than the standard visual method incorporated in the recent British standard. The authors could not however, get much sense out of the acetic acid-salt spray test with regard to the effect of ageing—this test gave results which did not conform with the results of the solution tests. Although the drop-dye test revealed aged coatings—however sealed—to be good, the sensitivity of test could be restored, according to the authors, by dipping in nitric acid, prior to applying the drop. Nitric acid, as is well known, is a notorious "seal-breaker" and the advisability of this move is somewhat in doubt. It was encouraging to note that the breakdown voltage and presumably resistivity of anodic coatings increases with time—this is of interest for electrical applications.

The authors proved that the nickel sulphate sealing method did not give the same degree of ageing as the other sealing methods investigated, even when used at temperatures of 60-80°C. for sealing purposes. Rightly or wrongly—and we should suspect this until concretely proven—the authors assumed that nickel sulphate sealing was a very good method, and merited commercial use—even at temperatures well below 100°C.

The next paper, given by Mr. J. M. Kape, of Aluminium Laboratories, Banbury, discussed the current and possible future methods of Architectural colour anodizing. The author divided the methods into two groups :—

(a) Ordinary sulphuric acid anodizing, as at present utilized in captive plants in the U.K. and U.S.A. to give 15, 25 or 35μ coatings.

(b) "Built in" colour-anodizing techniques at present used in the U.S.A., utilizing high voltages and usually organic acid electrolytes.

Type (a) could be dyed or pigmented with light-fast materials, and the properties required of these colours was closely summarized, with the sealing treatment to use. Type (b) electrolytes were either hard anodizing type solutions, using sulphuric acid at 0°C. ("Duranodic" and" Sandford" processes) or else mixtures of acids, usually organic acids (Kaiser "Kalcolor" process).

Mr. Kape made it clear that although electrolytes of this type were in vogue, producing coloured anodized aluminium of high light fastness and durability, the type of colours obtainable were necessarily restricted, and also extremely expensive to produce, owing to either the costly electrolyte, low temperature or high voltages involved. He considered that the use of oxalic acid should be utilized for architectural colour anodizing, as it was cheap, the voltages required were not excessive, the process operated at room temperature, and attractive built-in colours were produced at coating thicknesses of 25 to 35μ, which could also be dyed with the conventional architectural dye stuffs. Moreover, on architectural alloys the oxalic acid coating was more corrosion resistant than the sulphuric at any one film thickness.

Mr. G. Ernst (Sidal, Belgium) and M. Darnault queried the use of 35 microns for Architectural purposes, considering it made production difficulties, and was not really required for even severe atmospheres. Mr. Kape pointed out that 25μ H_2SO_4 anodic coatings had corroded considerably after 5 years in severe locations in the U.K., and hence the BSI had recommended a 35-grade in the recently published revised BSI615, on anodizing. M. Darnault emphasized the importance of cleaning and maintenance of architecturally anodized Al, and Mr. Kape agreed, stressing whatever the thickness of the film, it should be cleaned regularly. Dr. Sacchi also doubted anodizers' capacities to produce such coatings of 35μ, but Mr. Kape assured him that with the conventional architectural electrolyte of 15 per cent W/W H_2SO_4, used at 15 amp. per sq. ft. for over one hour, at 20° C., a 35μ film could be produced using conventional 24-V rectifier or generator sets.

The last paper of the session was an interesting article on the types of dye stuff used for dyeing anodic films and was given by C. Th. Speiser of Durand and Huguenin Limited S.A., Basle. Mr. Speiser summarized the different types of dyes from the molecular structure aspect, and then pointed out the influence of the alloy and hence, type of anodic film on dye uptake. He dwelt on the conditions required for sealing also, and showed many attractive colour slides of colour anodized buildings in various parts of the world. There was no discussion on the paper, however.

Final Technical Session

The following morning the last technical session was concerned with five papers. The first, again by Professor Tajima dealt with the corrosion by water of anodized aluminium kettles, which had got out of proportion in Japan. The kettles are anodized in oxalic or sulphuric acid to medium film thickness and sealed in steam. Corrosion was more intense on the sulphuric acid anodized kettles—as far as amount was concerned, but deeper pitting was caused by the oxalic acid film. Copper contamination of the water was the cause of the trouble, and city water contained more Cu than well water. The thicker the anodic film, obviously the better resistance to corrosion.

During the discussion various speakers (Dr. Zeerleder, Switzerland; Dr. Frary, Alcoa, U.S.; Mr. F. C. Porter, A.D.A., U.K.) doubted the use of anodized kettles in this instance and felt that unanodized kettles would have been preferable. Dr. Frary also suggested, from his previous wide experience of this type of problem, that the presence of as little as 1 p.p.m. Co or 1 p.p.m. Mn in water can produce very intense corrosion on Al. F. C. Porter commented on the best alloy to use for kettles, and said in the U.K., the N.3 (1¼ per cent Mn alloy) was widely used, and also 99.99 per cent clad N3 had been used with great success.

The next paper by E. Bloch and E. Zurbrügg (Soc. Anonyme pour l'industre de l'Aluminium Centre Researches, Nenhausen am Rheinfall, Switzerland) entitled "Aluminium Alloys for Anodic Oxidation" did not tell us a great deal new. The effect of various alloying elements and intermetallic particles present in aluminium, on the response to anodic oxidation is well known.

For the production of bright anodized (polishing quality) materials a preheat to 600°C. of 99.85 to 99.90 per cent Al base materials is essential prior to rolling, and the Fe content should be no greater than 0.04 per cent and if possible no more than 0.025 per cent. The effect of other alloying elements such as Si, Cr, Mn etc., which produce colour on anodizing was also discussed.

Mr. A. C. Wood of I.C.I. Metals Division, Birmingham, presented the next paper on "Titanium Jigs for Anodizing and Brightening of Aluminium Alloys," which was a very concise account of the present U.K. position. Mr. Wood accurately pointed out that an all-titanium jig was economical only on long production runs of one type of component—such as obtained in captive anodizing plants—and showed figures to prove these points. Titanium builds up a conducting oxide film during the anodizing process which

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6TH INTERNATIONAL CONFERENCE ON HOT-DIP GALVANIZING

INTERLAKEN JUNE 5-9, 1961

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Session 3

Chairman : DR. R. HAARMANN
(Siegener A.G.)

The Weldability of Hot Galvanized Steel

R. BOEKHOLT
(Philips Bedrijfsapparatuur Nederland N.V.)

ALTHOUGH it was not possible to examine all types of joints, the author selected a variety in the tests carried out to obtain a clear picture of the influence of galvanizing on the arc-welding process. Various electrode types were compared and related to the joint shapes, welding tests and plate thicknesses. Electrodes with low-hydrogen and rutile coatings were mostly used.

In most cases the fusion of the welding electrode became more disturbed and it was found that the solidification rate and fluidity of the slag play an important part in the welding of galvanized steel. Submerged-arc welding was tested with a combination of welding powder and wire, as was automatic welding with carbon dioxide as a proctective gas.

The author found that the factors which determine whether a material is weldable include the following : the rate of travel ; the choice of electrode, particularly with regard to the fluidity of the slag : the shape of the joint and the thickness of the coating.

The very high rates of travel in automatic welding produced gas inclusions in the weld and an irregular welding process, with the result that the appearance of the weld became very rough. When downhand welding standing fillet joints, the rates of travel with various types of electrode are higher than for other joint shapes. The best results were obtained with an electrode of the rutile organic coated type with a thin-flowing slag.

A zinc coating thickness of over 150 microns, was found to have an adverse effect on the weld, especially in the case of fillet joints. With standing fillet welds there were deviations such as sagging welds, undercut and rougher appearance. In these circumstances the Philips 38 yielded the best.

The author concluded his paper with the following observations. The weldability of galvanized steel structures is good provided the correct electrode is used and the rates of travel are not too high. In these circumstances the mechanical properties of welded joints on galvanized steel are practically the same as those on ungalvanized steel, although the crack sensitivity of welded joints is greater if welding is done with a rutile electrode. Low-hydrogen electrodes are recommended for welds where there is a risk of crack-formation otherwise the zinc coating must be burnt away locally.

The Assembly of Galvanized Steel by Welding

M. PUECH
(Association Technique Française de Galvanisation)

THE author, owing to the fact that generated heat during arc welding destroys part of a galvanized coating, sets out to determine the effect of zinc on the physical and mechanical properties of a weld and possible methods of reconditioning the coating in the weld area.

In order to embrace all the likely practical conditions, butt, lap and fillet welds, produced with both rutile cellulose and basic-coated electrodes, were examined. The specimens were taken from commercial Thomas steel sections, which conformed to the French standard A 35-101, and the two types of electrodes were to French standard A 81-309.

Normal treatment was applied when galvanizing the specimen, *viz.* degreasing, rinsing, pickling in hydrochloric acid, double rinsing, fluxing with 60 : 40 zinc ammonium chloride, preheating to 120°C and immersing in zinc at 440 to 450°C. The zinc pick-up was approximately 600 gm per sq. m.

In the three mechanical tests performed the welded joints proved equal to or better than, the parent metal. There was generally an improvement in the weld properties, regardless of the type of electrode used.

The author found that the quality of welds made with the basic coated electrodes lead to some reservations about their use although the mechanical properties were not adversely affected, nor were they affected by the presence of zinc on the plates.

The Reconditioning of Damaged Galvanized Surfaces

J. F. H. VAN EIJNSBERGEN, R. GLOOR, J. F. ROUFF
(Stichting Doelmatig Verzinken, Verzinkerei Kummler and Matter A.G., Et. Schmid)

ALL the methods dealt with by the author, in this paper refer only to repairs on freshly galvanized items, and particular emphasis is placed on the deterioration of the zinc coating during welding operations.

The zinc coating does not apparently disappear completely during the welding process. Below 900°C the main alloy layer is the zeta-layer and above this temperature zinc will oxidize to ZnO, which mostly vaporizes and also forms a thin precipitate around the weld.

A pattern has been observed on all welded galvanized sheets and angles in which the zinc coatings absent only on the weld itself, where all zinc has been oxidized to zinc oxide. There are then two distinct zones of combustion, the first immediately adjacent to the weld in which the zinc has only been partially oxidized and has

partly alloyed with the steel. The pale yellowish precipitate of zinc oxide, contaminated with iron, can be easily brushed off. This layer is of practical importance as it will temporarily prevent corrosion and enable repairs to be postponed until the whole structure has been assembled. The second zone shows an abrupt increase in thickness and consists mostly of zeta-layer, which changes rather quickly into the normal zinc coating.

The author suggest that a material having the following characteristics should be used for the repair :

(a) Easy to apply by unskilled labour, preferably without costly equipment.
(b) One application should give a relatively thick coating which remains well adherent.
(c) It should offer the same corrosion resistance as the undamaged surface around the reconditioned spot.

The authors then investigated several materials and methods of applying them and summarize their work by saying that repairs can be effected by means of zinc-rich paints, zinc spraying or repair sticks consisting of zinc or zinc alloys. In some isolated cases zinc alloy powders, tin solder and anti-corrosive paints may also be used.

Provided the spots are adequately cleaned and pretreated, sufficiently thick and non-porous coats of these products will give a corrosion resistance equal to that of the adjoining areas of the hot galvanized structure, although in very moist areas a zinc rich paint or repair stick give better results than zinc chromate or calcium plumbate primers. Finally a coat of aluminium paint applied over a zinc-rich paint or sprayed zinc coating increases corrosion resistance and mitigates differences in appearance.

DISCUSSION

MR. A. BIANCHINI (Centro Ricerche Metallurgiche) said that the papers were very interesting because they dealt with the problem of welding galvanized steel in such a way as to produce experimental data of which there was great need. With regard to endurance, it was well known that breakage by fatigue could be caused very easily by the presence of small surface defects, such as the inclusion of macro and micro cracks, etc. There were many cases in which breakage through fatigue could be seen both in the preliminary phase of surface preparation, shot blasting, or in galvanizing as such. There were cases of aggressional attack of the basis metal by zinc which were often irregular. One defect only was sufficient to bring about a fatigue failure. Also in the welding of galvanized work fatigue failure was caused due to the presence of very small quantities of zinc oxide and the formation of cracks, due to the presence of inclusions. All this led to one question ; had stress tests been undertaken on galvanized work and welded work, and what was the result ? A similar question could be put to Mr. Puech.

Mr. Bianchini's company had obtained results on the weldability of galvanized steel which completely supported those stated by Mr. Puech. Unfortunately they had not had any possibility so far of working on resistance to stress.

Basic Rules for Welding Galvanized Steel

Welding of galvanized steel could take place provided that certain basic rules were followed. Among these he wished to put the low speed of the welding part compared with welding done on non-galvanized steel.

With regard to the paper presented by van Eijnsbergen, Gloor and Rouff, dealing with the reconditioning of damaged galvanized surfaces, he wished to say that reconditioning was also given by means of varnish painting and anti-rust paint, and that they had found the results to be excellent. The varnish used was a calcium-lead varnish, COP, which also worked very well on zinc and steel and had given very satisfying results.

Outdoor Exposure Tests

MR. E. C. MANTLE (British Non-Ferrous Metals Research Association) said that work done by the B.N.F.M.R.A. paralleled very closely that reported by van Eijnsbergen, Gloor and Rouff, but instead of adopting their practice of using accelerated corrosion tests to determine the efficacy of these various repair methods they had done prolonged outdoor exposure tests which had now been going on for five years. These tests had been done at a marine site and at an industrial site, and four methods of repairing the galvanized coating after welding were used. The first one was by zinc spraying, the second by a brushed coating of zinc-rich priming paint, the third was with a calcium plumbate priming paint, and the fourth was with a zinc-rich priming paint followed by a coat of aluminium paint. They also had control specimens that were welded, but the damage caused by the weld was not repaired. In the case of the control specimens it was found that they rusted fairly quickly, giving a superficial red rust, but after about six months this turned to a dull brown colour, and this rust layer seemed to be quite protective and nothing further happened to these samples until they had been exposed out of doors for about three years, when this rust layer broke down and rusting continued as one normally experienced it with unprotected steel. Like van Eijnsbergen, it had been thought that this stifling of the attack was probably due to the protective action of zinc corrosion products from the surrounding galvanized steel. All the protective treatments applied seemed to have been very effective. After four years the samples that were protected by zinc spraying, where the galvanized coating had broken down, showed absolutely no corrosion whatever. Those protected by the zinc-rich paint followed by the aluminium paint showed slight rusting in one or two spots, but the attack appeared to have been completely stifled, and nothing further was happening. Zinc-rich paint alone gave practically complete protection

at the marine site but there was a little breakdown and some slight rusting at the industrial site, and the calcium plumbate primer showed rather the reverse result : there was a slight attack at the marine site but practically none at the industrial site. The tests were continuing and it was hoped eventually to be able to make more precise recommendations about the best methods of treatment. But they would agree with Dr. van Eijnsbergen and his colleagues that all these methods were reasonably satisfactory.

With regard to the paper by Mr. Puech, he had an appendix dealing with gas and bronze welding as a means of joining galvanized steel articles. He was rather surprised at this suggestion that bronze welding should be used because it was well known that copper alloys were strongly cathodic to zinc, and one would have expected that making a joint in a galvanized article by a copper-based alloy would be one of the best methods of causing accelerated attack on the galvanized steel, and he would be interested to know whether there was any practical experience of the results of this technique of joining.

Galvanized Steel in Motor-car Equipment

DR. S. RADTKE (American Zinc Institute) thought that the two papers on welding were very important. Because of its importance in industry the Budd Company in Philadelphia, had undertaken an investigation of improved methods for joining galvanized steel by resistance welding, and there had also been a very great interest, because of the use of galvanized steel, in automotive mufflers or silencers. This new application for galvanized steel had created tremendous interest in these techniques. The big problem is that in high-speed production welding, the electrodes tend to suffer premature failure, since virtually all resistance welding records were of copper-based alloys. It was apparent that there was a tendency to form a brass- or copper-zinc alloy inter-face, and this in turn, because of its higher electrical resistivity and lower physical properties, caused failure. On slow production runs this was not significant but in high-speed welding, with welds up to 100 per minute or more, and in particular in automotive production fixtures, welding jigs and fixtures, it was not possible to tolerate this premature failure. Their research effort was designed to study all the parameters on current pressure, electrode composition and also the variables which existed in the zinc layer itself. Preliminary photographs pointed to these zinc layers as having a very significant effect upon weldability. However all the data was not completely confirmed, but their reports, would be made available to all who were interested, so that these techniques could be applied as rapidly as data on welding developed.

He wished to comment also on Mr. van Eijnsbergen's work on finishes for galvanized steel. The automotive industry, desiring to expand its usage of galvanized steel, needed a decorative finish, but their techniques and knowledge on painting and finishing galvanized steel were woefully lacking, and it was certainly valuable to see that Mr. van Eijnsbergen and his associates were undertaking this work, but it must be expanded in the future.

THE CHAIRMAN (Dr. R. Haarmann) asked Dr. S. Radtke if there was any experience in the United States concerning the welding of three or more parts. He also asked for any information concerning the welding of materials of different thicknesses.

Thicknesses Welded

DR. S. RADTKE replied that in the case of automotive bodies they welded everything from 0.030 in. to about 0.080 in. When they assembled the body they had the variation in gauge thickness : it was 0.030, 0.075, 0.080, 0.050, so that they could weld these multiple thicknesses without significant difficulty. The question had been raised before about the fatigue characteristics of welded galvanized joints. He would have said that in this case fatigue resistance of these bodies assembled by resistance welding was outstanding. As a matter of fact, the tests run by the Ford Motor Company indicated that the fatigue characteristics of these joints were at least equal to the fatigue characteristics of uncoated body steel, so that here they had no problem. However, once one had an effective welding of a steel-steel joint (not a zinc-zinc joint, which would very probably fail) the joint was very sound. The normal method of testing was the chisel test, where the chisel was driven in between the two pieces of sheet steel which had been joined. A satisfactory weld would permit one to tear out a nugget from one of the pieces of steel, and this was the best test for a sound joint. If one had only a zinc-zinc joint it would simply fracture at the zinc-zinc inter-face, indicating an unsatisfactory job. In welding these bodies many of the brackets, stiffeners and other components for supporting the engine and the under-body were heavier gauges of steel welded directly to the galvanized sheet, and there was no problem whatsoever with these joints, so that it could be said that they were able to weld many pieces together. They could also weld variations in gauge. Many of the body sections were very deep-drawn sections. These were made without failure of the galvanized coating, and many of the people felt that it was easier to draw galvanized steel in these body sections because the galvanized coating provided inherent lubrication and at the same time it flowed readily over the die faces.

THE CHAIRMAN again asked whether it was possible to join three thicknesses.

DR. S. RADTKE replied that a three-component system could be joined together,

MR. J. R. ROUFF (Etablissement Schmid), referring to Dr. Radtke's remarks about the automotive industry, said that another aspect of the problem was resistance welding, because if it was successful they would then have a new field of application for galvanized sheets which would be very wide. He hoped Dr. Radtke would say something about resistance welding in the United States.

Seam Welding

DR. S. RADTKE replied that he understood Mr. Rouff to mean seam welding, where one had two continuously rotating electrodes. This could be done, and done effectively. There should be no difficulty as compared to the single welds which were made by conventional resistance welding methods. The only difficulty was that again one undoubtedly had to replace the electrodes much more frequently and to use the highest strength electrode materials. The two electrode compositions which appeared to be best for this were the copper-zirconium alloys and the copper-chromium alloys. When using these electrodes they must be cold worked to maximum physical properties to have maximum life during welding. Electrode geometry, i.e. the shape of the electrode, was very critical, and it must be so designed that there was maximum support for the actual welding face in order to withstand repeated high-speed welding. One other factor was that it must be recognized that with the galvanized coating it was more difficult to weld. It took approximately 25 per cent more current to make an effective weld in galvanized steel by this method. However, while the range was rather critical, the automobile people said that by having to weld galvanized steel they had improved their own techniques for resistance welding uncoated steel. The present indication was that the automotive people wanted to make very much more of the body from galvanized steel, and already preliminary indications showed that the life of a body had increased well over three times as a result.

MR. M. H. DAVIES (Zinc Development Association) said that he would like to endorse entirely what Dr. Radtke had said about the importance of this not only in the strip galvanizing field to which it directly applied but also to the general galvanizer, because of the indirect publicity that galvanized steel would get from this most important use. Dr. Radtke had also mentioned that he hoped European countries would follow the practice in the United States, and he was sure they would be interested to know that at least a start had been made in England, with the use not yet of continuously hot-dip galvanized steel strip but of electro-galvanized strip for the under-body parts. He was sure that in the course of the next months or years they would find that there would be a transfer from electro-galvanized to continuously hot-dip galvanized.

In addition to the report that Dr. Radtke had mentioned from the Budd Company, at the Z.D.A. they had a complete report on the work of the Ford Motor Company, and in addition there was a separate Z.D.A. report on American practice in general. This covered the operations in the motor-car companies and dealt not only with the welding but also with the forming and bending of galvanized strip. In addition it contained some valuable information about the production of the special grades of hot-dip galvanized strip that were used in the automobile industry. The Z.D.A. would be glad to make these reports available to anybody who wanted them.

AUTHORS' REPLIES

MR. PUECH, in reply, said that Mr. Bianchini had asked whether they had already achieved some results concerning resistance to fatigue after welding of galvanized sheets. This experiment was being carried on, but part of his reply had been given by Dr. Radtke. These results would have to be checked as regards arc welding. As Mr. Rouff had pointed out, they were now still in the initial stages in this subject. The results had, however, been sufficiently positive for a first industrial application. Photographs were exhibited at the Conference concerning the Air France building in Orly Airport, and a second method which was now being used in Paris.

Mr. Mantle had asked a question dealing with the presence of bronze and copper in connection with zinc welding. This problem had been discussed exhaustively. Perhaps someone present could give them some information on the Heliarc welding system in the United States. Using this technique they were able to produce some specimens which after 300 or 400 hours of testing seemed to have resisted. In France they had been welding galvanized tubes to copper tubes without finding them damaged.

In his introduction Mr. Rouff had indicated some of the differences between Mr. Boekholt's paper and that by himself. As regards the type of basic cutting he personally did not see any such formal contradiction between the results obtained by Mr. Boekholt and those obtained by themselves. Actually the electrodes of rutile type showed satisfactory results in the vertical position. The only difference was in the number of bases and he himself was wondering why there

should be three rather than two bases. They had two types of rutile electrodes which had given satisfactory results. The only chapter where Mr. Boekholt seemed to recommend basic electrodes was that concerning the cracking tests. They must not confuse the two terms, cracking and blowing. He wished to ask one question on Mr. Boekholt's report as regards the welding of galvanized steel. They had noted no noticeable disturbances of the fusion of the electrode in the course of the welding. As regards the cracking test, with the resistance type of welding, the French Technical Galvanizer's Association had now finalized a large testing programme together with the French Welding Institute, and he thought it would be desirable to remain in close contact with them in order to join efforts so as to obtain satisfactory results.

Calcium Plumbate Primer

MR. VAN EIJNSBERGEN, in reply, said that he agreed with Dr. Bianchini that the use of a suitable calcium plumbate primer for reconditioning welds gave very good results because it adhered as well to steel as to the galvanized surface, but he did not agree that zinc spraying was a better proposition than the application of a zinc-rich paint or calcium plumbate paint. Zinc spraying could be used but it had three disadvantages. First of all, the surface of the weld must be either sand-blasted or grit-blasted, otherwise the sprayed zinc could not adhere. Second, for the spraying of the zinc one required an apparatus on the spot, and that apparatus was much more complicated than a simple brush. Third, if the zinc spraying was done very well, so that the spot which was reconditioned would not corrode prematurely, it must be done by a very skilled man. He did not need to say that these men were not very readily available today.

Humidity Tests

He wished to compliment Mr. Mantle on his very valuable addition to the work they had done. They had worked in two directions and it was pleasant to see that the humidity tests which had been carried out by the aid of his friend Mr. Sjoukes and Mr. Mantle's tests in a marine and industrial atmosphere had almost the same result. If he might say a word about accelerated tests, they had avoided using a salt spray apparatus, because testing zinc surfaces and reconditioning zinc surfaces in a salt spray cabinet was of no value when the results were compared with actual practice. However, when using a humidity cabinet for a temperature of about 35°to 40°C., with a relative humidity of 100 per cent and a time cycle of about 8 to 17 hours, one arrived at a rather good conclusion.

Session 4

Chairman : MR. A. OLLIVET
(Ets. Ziegler Paris)

Tests on Wet Storage Stain

W. F. WILCOX AND E. B. DISMUKES
(Southern Research Institute, Birmingham, Alabama)

THE authors discuss recent research carried out for the American Zinc Institute on the wet storage staining or white rusting of galvanized sheet. The underlying concern throughout the course being how to minimize the formation of white rust during normal temperature and humidity cycles in storage.

With this in mind a survey was made of the various methods available but no method was investigated that could be endorsed unequivocally as an alternative to chromate treatment. One feature of chromate inhibition that has proved difficult to approach with other agents is inhibition at concentrations as low as 10 molar, but a continuing survey of new agents is being made with emphasis on organic substances that form insoluble zinc compounds.

Comparisons of aluminium-containing and aluminium-free sheet give some quantitative support for the often expressed view that wet storage stain is more severe on continuously galvanized strip which usually contains aluminium in the coating.

From the point of convenience and reproducibility, the authors conclude that for evaluating white rusting, the methods involving immersion in distilled water, either leading to a weight-loss determination or to an instrumented detection of the rate of white rust formation, may be found useful for quality control in galvanized sheet production.

The Corrosion of Zinc in Dilute Aqueous Solutions

R. C. WEAST, L. J. KOTNIK AND D. M. GEEHAN
(Case Institute of Technology, U.S.A.)

IN the paper the authors review some previous work on the rate of zinc corrosion and oxidation which in nearly all instances have been performed with zinc in solution when the total pressure on the systems was approximately one atmosphere. In addition the paper presents new data for zinc corroded in solutions at one atmosphere pressure and in solutions having air, nitrogen or oxygen at three atmospheres, above the solutions.

The paper is well illustrated with both tabular and graphic results from the investigation and from which the authors draw the following conclusions :

(1) When zinc corrodes in aqueous systems pressurized with air or oxygen there is no maximum in the corrosion rate at 60°C.

(2) For a given solution and a given oxygen concentration the corrosion rate of zinc is only a function of the solution temperature.

(3) Zinc potentials become enobled in chloride solutions even in the absence of carbonates, bicarbonates or nitrates if the zinc corrodes in systems pressurized with air or oxygen.

(4) Oxidizing agents that do not produce molecular oxygen and which do not form insoluble zinc compounds do not cause enoblement of the zinc potential.

(5) The quantity of zinc corrosion which occurs during the first 24 hours in hot potassium solutions under pressure is the same if the temperature is between 50°C and 80°C.

(6) The ratio of amounts of ZnO and $Zn(OH)_2$ occurring in the corrosion products is a function of the time the metal has corroded.

(7) The zinc corrosion products formed at 88°C are about 1000 times more electrically conductive than those produced at 25°C.

(8) The corrosion products of zinc in very dilute aqueous solutions are produced by a stepwise process which involves replacement of water molecules on the hydrated zinc ion.

DISCUSSION

MR. J. F. H. VAN EIJNSBERGEN (Stichting Doelmatig Verzinken), in opening the discussion, said that in Holland galvanized water spraying pipes used in greenhouses and carrying water at room temperature, showed severe pitting corrosion ; the pipes became perforated within 24 to 30 months of use. These holes were invariably 1 to 2 mm. in diameter and showed a whitish range of zinc salts around the hole. Experiments had shown that these holes only appeared on the bottoms of the spray pipes containing tap water. Neither the water pipe nor the presence of bronze valves on the spraying nozzles in the system affected this pitting corrosion. Also the location of the pipes and the steel quality and the composition of the zinc coating had no traceable influence on this corrosion. Did Professor Weast and his co-workers have an explanation of this pitting corrosion, which was rather unique on such galvanized pipes.

With regard to the paper by Wilcox and Dismukes, while investigating products which would prevent white storage stain the authors had not considered the fact that a number of such products or solutions were highly detrimental to the adhesion of paint coatings on such galvanized sheets. It was known that strongly absorbed, very thin layers of organic salts were difficult or even impossible to displace from the zinc surface. Apart from the various chromate conversion coatings, encouraging results had been obtained with polyvinyl butanol solutions. The very thin layers of zinc with polyvynyl butanol would prevent white storage stain and at the same time offer an excellent key for a large number of paints, varnishes and lacquers.

Pressure of Water System

MR. W. L. HALL (General Galvanizers Ltd.) said that he believed this study was the first in which the effect of pressure in the water system had been considered. For hot-water systems in the United States, and probably in countries in Europe, this was of considerable importance, because such systems worked under the pressure of the water main. In England, on the other hand, the hot-water systems were generally working under very low pressure indeed because of the regulations, which meant that the pressure drop had to be introduced in the system by means of a cold storage tank.

If he had understood Professor Weast's results correctly it would seem that the effect of pressure was to cause rather more general corrosion, or rather corrosion of zinc, at a more general rate, since there was no maximum in this temperature range of about 60°C. Was he to understand that the over-all corrosion rate remained just the same, for he knew that from American practical experience the corrosion of galvanized hot-water storage vessels had been found to be very considerable ? Would Professor Weast think that the much lower pressures, equivalent to possibly only 20 ft. head of water, used in England, would have any significance on the corrosion rates, and would he think that the effect of pressure would have any influence on the remedial measure, of using magnesium anodes which was very helpful if the water had high conductivity ?

Tests in Distilled Water

Turning to the other paper on wet storage stain, he was rather amazed to see that the authors favoured a test for evaluating the effectiveness of protective treatments which was merely the immersion of the treated surface in distilled water. They said that this test was more reproducible than any stacking test, but surely the real problem in wet storage stain only occurred when articles were stacked with films of water between the zinc surfaces, and he had always understood that this fairly rapid corrosion which could occur in such circumstances was due to the peculiar conditions of the presence of water and lack of excess of oxygen which occurred when a film of water was trapped between two surfaces.

DR. S. RADTKE (American Zinc Institute) said that he would speak for Wilcox and Dismukes, With regard to the programme carried on at the Southern Research Institute (Birmingham, Alabama U.S.A.), he would comment on the programme generally and in particular on the tests which they had developed. First of all he believed that this light reflectance on the surface could be critized in the manner that Mr. Hall had criticized it. He felt that it had serious limitations because of the fact that it did not completely reproduce conditions which would occur in a coil of galvanized sheet or in a stack of galvanized sheets where one had moisture condensed from the atmosphere, absorbing oxygen and establishing a differential aeration cell. He felt that any accelerated corrosion test leaves much to be desired. On the other hand, if one could develop a test which would simulate conditions which would occur in practice, or which duplicated more closely other testing techniques, and if one could remove from any of these evaluations the human element and permit an instrument arbitrarily to establish the rate of corrosion, he believed they would have progressed significantly.

Light Reflectance Test

In the tests which were made on this evaluation of the light reflectance test it had been found that it did behave consistently. There were some minor improvements which must be made, and the authors were continuing this work under other sponsorship. Nevertheless he personally felt that the test had a good deal of merit in it, not only from a laboratory standpoint but from a very practical commercial standpoint, to permit plants to check the behaviour of the materials they produced.

A paper describing this development in much more complete detail would be prepared eventually, but he hoped that, despite the criticisms which had been made and the limitations which appeared, they would find that this test had a good deal of merit. It was quite easy to set up an instrument recording the rate of production of the corrosion products. It could be done without any human observer, because the build-up of corrosion products was measured by light reflectance from these products and was measured through a potentiometer and in turn there was a very cheap and simple recorder to show the rate of build-up of the product. This again was very fast and took place only in a matter of hours and was completely instrumented.

He hoped that the authors of this paper would not ignore the paintability factor. They recognized this as a very vital factor in any treatment for minimizing wet storage stain. Nevertheless they were looking for new areas and new techniques for eliminating wet storage stain. They did not feel they had found anything that was very much better than the chromates. For this reason they felt they must take another look at techniques for trying to minimize this problem. The problem was still with them and was becoming very serious, particularly in the automotive industry, and for all these reasons they felt that it was a problem needing continuous effort, and they planned to support this.

AUTHORS' REPLY

PROFESSOR R. C. WEAST (Case Institute of Technology), dealing first with Mr. van Eijnsbergen's question, said that it was quite evident that he had surveyed this problem quite fully because he had mentioned that among the factors he had considered were that, the temperature of the water and the location of the pits always being in the bottom of the spray pipes, the type of water and the presence or absence of bronze valves in the spraying nozzles might be of importance. He had also considered the steel quality, the location of the pipes and the composition of the zinc coatings, and he had come to the conclusion that none of these had any influence on the corrosion. This left very little to be considered as to the cause of this problem. He was inclined himself to think, however, that it was probably nothing which was dissolved in the water. It was his opinion that, inasmuch as it occurred in the bottom of the pipes, it might well be something which was suspended in the water and which settled on the pipes during those periods when the flow of the water had been stopped.

Mr. van Eijnsbergen had asked whether he would consider this a matter of oxygen concentration. He felt that the initiation of the pits most probably was not one of oxygen concentration because the oxygen would be very nearly uniformly dissolved throughout the water. However, after the pit had started to form oxygen concentration cells might well develop, and hence his question regarding such cells. The answer to it might be that in the beginning oxygen concentration might not be a factor but once the pit started oxygen concentrations might be a factor.

Dealing with the questions posed by Mr. Hall, he had asked whether the over-all corrosion rate decreased with a decrease in pressure, and his answer would have to be yes, it did, but one should keep in mind that pressure alone was not a cause of the difficulty.

Some of the figures in the report showed that the pressure of air being at three atmospheres caused less corrosion than the pressure of oxygen being at three atmospheres. Thus pressure was only the cause of the corrosion if it were causing more oxygen to be dissolved in the water. If it were causing more inert gases such as nitrogen or helium it would cause no increase in the corrosion. Mr. Hall had asked further whether the use of magnesium anodes would be helpful in repairing the corrosion of galvanized hot water storage tanks. He understood him to limit this to those which had reasonably high electrical conductivity. Such anodes were beneficial in retarding the corrosion rate in galvanized containers. It was perhaps unfortunate that there was no definite conductivity which permitted the stopping of corrosion. If the water were too highly electrically conductive corrosion would probably be so rapid that the magnesium rate could not by itself provide the protection; and, as implied by Mr. Hall's question, if the conductivity were low the magnesium anode could not provide protection to the galvanized tank.

Session 5

Chairman : MR. A. OLLIVET
(Ets. Ziegler Paris)

Chromating

C. W. OSTRANDER
(Allied Research Products Inc., U.S.A.)

THE author has endeavoured to review the wet storage stain problem with particular reference to the current use of chromate-type corrosion inhibitors. Active research and development in this field continues

by both supplies and users and there is much information in the paper regarding the protective value of these coatings in all their phases and acceptable methods of evaluating the coating.

The conclusion of the author is that the economical and physical characteristics of chromate conversion treatments satisfactorily answer many of the problems encountered. The range of these products in use, not only with hot galvanized surfaces, but also with electrodeposited zinc and cadmium, zinc die castings, aluminium, copper, magnesium and silver more than indicates the versitility and the general overall acceptance of the treatments.

Painting Hot Galvanized Steel

J. F. H. VAN EIJNSBERGEN
(Stichting Doelmatig Verzinken, The Hague)

THE scope of this paper is restricted to freshly galvanized smooth surfaces which present adhesion problems requiring special paints or pretreatments, and it discusses some of the developments which have taken place since an earlier review of the subject.

Galvanized steel is a much better basis for paint systems than any anti-corrosive paint because the dense metallic zinc coating is alloyed to the steel base and gives cathodic protection to the steel when damaged locally. It has been established in practice that the average durability of a well chosen paint system on galvanized steel is considerable higher, some 25 to 30 per cent, than the sum of the average durabilities of each coating alone. Moreover, the reconditioning of paint coats on zinc surfaces is less difficult and cheaper than on steel.

The paper deals particularly with developments in phosphating, wash primers and top coats since 1956. As the calcium plumbate (COP) paints have been considerably developed during the last five years, special reference is made to this important group, which can be directly applied to freshly hot galvanized steel without chemical pre-treatments or wash primers. The principles on which the lasting adhesion of the paint films is based is discussed at length and details on the general composition of suitable COP paints are indicated.

The results of a great number of outdoor exposure tests are also described and a tentative specification has been established for air-drying COP paints on hot galvanized steel together with some recommendations as to their ingredients for the benefit of the galvanizing industry, the users of paint and the paint industry.

DISCUSSION

MR. M. MORISSET (Chambré Syndicale des Fabricants de Tôle Galvanisée) said that he had the intention of presenting a supplement to a remark made by Mr. van Eijnsbergen dealing with the techniques of painting galvanized surfaces, and drew attention to experiments carried out by the Chambré Syndicale des Fabricants de Tôle Galvanisée on the corrosion behaviour of zinc plus paint. Three years ago, at the previous conference, he had presented the results obtained from accelerated corrosion tests carried out on marine sites and industrial buildings. The specimen of galvanized sheet was found to have shrunk on both sides. Ten different types of paint were used. The results were still visible in the colour slides which were published in the conference report. Along with these accelerated corrosion test results had been placed the specimens of galvanized sheets coated with identical paint and exposed to natural atmosphere in a number of stations. First of all there was the effect of the rural atmosphere of St. Germain and then the industrial atmosphere in St. Denis, and also the marine atmosphere in Biarritz, at the marine museum there. These specimens had been exhibited for about four years and he showed some slides showing their present condition.

They had been able to see the generally satisfactory condition of these specimens, and although he could not give them any specific indications concerning the estimates of the actual durability, nor the comparison with the various specimens, the experiments were continuing and the specimens were still being exposed to atmosphere in the various stations, and he hoped that at the next conference they would have a sufficient number of specimens and sufficient information to be able to make a proper comparison between those exposed to natural atmosphere and those suffering from accelerated corrosion.

Problem of Paint Adhesion

MR. A. T. WALKER (Associated Lead Manufacturers Ltd.) commented that the painting of galvanized iron was increasing considerably in the United Kingdom and probably elsewhere, and the problems of adhesion were considerable. In his laboratories experiments on the painting of galvanized iron has been carried out over the last ten years and it had been found that without exception the incorporation of calcium chromate into any paint medium would give a noticeable improvement in adhesion. A primer could be made for application to galvanized products immediately after galvanizing and before leaving the works, and its use gave satisfactory results. It could be painted with a number of decorative finishes. Some five years ago a series of experiments had been conducted to compare the effect of various treatments on galvanized iron with the use of calcium chromate primers, and it might be opportune to mention some of the results. A number of panels were given one of the following treatments : a simple white spirit wash to remove grease and oil ; a phosphoric-acid solution treatment ; and the application of a special primer. Over these panels were painted a number of primers, and in addition to these treatments one panel was not given any treatment at all after galvanizing. Three primers were applied : an oil-based calcium chromate primer ; an oil-based red-lead primer ; and a PVA with oxide. They were then coated with a simple white-lead finishing paint and exposed in the industrial atmosphere of Liverpool for 4½ to 5 years. After that time

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a scratch adhesion test was carried out on each panel and it was given a numerical rating in respect of adhesion. The figure " 1 " meant very good adhesion and the figure " 10 " meant very bad adhesion, and the results were as followed. The panels primed with calcium chromate paint were checked first and the untreated panel had an adhesion rating of 2. When given a white spirit wash it had an adhesion rate of 1. With the phosphoric acid treatment it also had an adhesion rating of 1. With the back etched primer the adhesion rating was 2, while with the oil-based red-lead paint the adhesion rating untreated was 6 ; with the white spirit wash, 6; with the phosphoric acid treatment, 6 ; with the back etched primer 3 ; and with the simple iron oxide paint the untreated panel gave a rating of 5 and the white spirit washed panel a rating of 6, the phosphoric-acid treated panel a rating of 4 and the etched prime panel a rating of 3. Thus the use of the pre-treatment on galvanized iron did improve the performance of non-calcium plumbate primers, but there was no reason for using any pre-treatment when a simple calcium chromate primer was used, and the results of the test indicated that the adhesion of the calcium chromate primers was considerably better than the adhesion of the other even with pre-treatment.

Mr. van Eijnsbergen's mentioned the reasons for the good adhesion of calcium plumbate primers to galvanized iron. He could not agree with the suggestion that the calcium plumbate reacted with zinc forming zincates and calcium carbonate. From the evidence quoted there was no doubt that under the conditions of test given by Mr. van Eijnsbergen one did experience etching of the zinc surface, and this occurred in the presence of water with calcium plumbate pigment in suspension.

AUTHORS' REPLIES

MR. OSTRANDER, in reply, said that as regards the inclusion of aluminium affecting the corrosion characteristics it had been his experience that this did happen, and they had very definitely found that it affected the type of chromating or protection which was used. Whether or not the clear as well as the coloured chromate conversion treatment could be applied immediately after galvanizing, he said it was normal practice to apply clear treatments in continuous strip operation immediately after the galvanizing. To date he did not know of any application where a coloured chromate conversion coating had been applied immediately following galvanizing. However, he did not see any practical reason why this could not be done. The use of potassium dichromate as a quench, had been and probably still was being used. However, it had been his own experience that the use of chromate plus other active ingredients provided a much higher degree of corrosion protection than could be expected of the single chromic acid or dichromate method. Under some conditions this type of treatment seemed to accelerate corrosion rather than to help to eliminate it.

MR. VAN EIJNSBERGEN, in reply, thanked Dr. Radtke for his kind remarks on the research into the painting of galvanized steel which they had been doing for seven years in Holland. Second, he wished to thank Mr. Morisset for his account of the work going on in France, which was very important. Third, he referred to a very important comment by Mr. Walker and said how pleasant the collaboration had been on the matter of calcium plumbate paints. The results could not have been obtained without his help. They were now doing some work on linseed oil to see whether the reactions took place due to the fact that water would be sealed in.

In conclusion he also showed some colour slides which clarified his paper.

(*To be continued*)

Aluminium Pre-Fabricated Bungalows

A GREAT deal of long-service experience of aluminium as a building material, over some 50 or 60 years, has established that when aluminium of the right grade is correctly applied to building components in accordance with recognized practice, entirely satisfactory service is achieved. The permanence of aluminium is fully recognized and accepted for roofing, side cladding, rainwater goods, windows and many other building items.

The alloy used for the extruded sections comprising the frames of the bungalows, as well as for the sheet and strip for walls and roofs, was known as " commercial grade aluminium " or " C.G.A." The alloy has a high copper content and this gives an intrinsic resistance to corrosion very much lower than that of commercial purity aluminium and of the aluminium alloy normally used for building purposes. The sheet material was provided with a thin coating of pure aluminium to protect the copper-containing alloy core and this has given excellent service even when unpainted, but similar cladding of extruded structural sections was impracticable.

There now exist ranges of British Standards and Codes of Practice covering aluminium for many building purposes, and additions are being made. The re-melted but unrefined alloy known as " C.G.A." has not been used for other building purposes, but very large quantities of aluminium of the correctly specified grades have been applied to buildings throughout the world.

AUTOMATIC PLATING FOR BRASSWORKING INDUSTRY

Developments at Peglers Ltd. Doncaster

AUTOMATIC equipment is now widely used by specialized sections of industry where, until recent years, manual operation has been the accepted method by which certain stages of production have been carried out.

The brassworking industry is such a case—particularly the section dealing with plumbers' brassware. Among the well-known manufacturers who have recently adopted automatic plating methods are Peglers Ltd., of Doncaster, whose taps, valves and general plumbing fittings are used throughout the world. As part of a modernization and development programme and to ease pressure on their existing plating facilities, a Canning "extended" "Gem" plating unit has been installed. The site chosen for the new plant was formerly the miscellaneous assembly department. After the area had been completely cleared it was refloored to take the "Gem" automatic. Walls are tiled to a height of 11 ft. and the whole section is decorated throughout in bright and attractive contemporary colour scheme.

The "Gem" Fig. 1. is a single-line automatic plating plant embodying all the well proven features of the "Trojan" design; the plant gives improved operating efficiency and simplified maintenance resulting from the elimination of chains and the reduction of switches. The "Gem" is a small fully automatic plating plant for the manufacturer whose output of a particular product is considerable and yet does not justify the installation of a large automatic unit.

The automatic installed for Peglers Ltd., is 56 ft. long and has a rated output of 60 jigs per hour giving a plated output of the order of 200 sq. ft. per hour. The plating process is arranged for nickel and chrome and there is provision for copper pre-coating if required.

The plant is in a specially prepared area with all ancillary equipment conveniently placed. The adjacent jig loading and storage area reduces the amount of walking and general labour involved maintaining the supply of work. Operation of the plant is controlled from a master panel Fig. 2. near the loading station and current to the nickel and chrome plating tanks is regulated by automatic current-density controllers. These units are situated at the side of the master control panel. The process is under the control of an electronic timer which permits instant variations of process timing if required. The plant is operated by a low-pressure hydraulic system, the power for which is provided by one pump unit driven by a 10-h.p. motor.

Process tanks are fabricated as separate units and arranged around the central conveyor structure. This has the particular advantage that tanks can be withdrawn for inspection or maintenance if required. The tanks are lined where necessary to suit the particular solution they contain.

In modern automatics using complex solutions, the necessity for maintaining the purity of the electrolyte is a matter of prime importance. Where a large flow of work is passing through an automatic plant the reject factor can become prohibitive due to the inferior deposits caused by impurities and suspended solids in the solution.

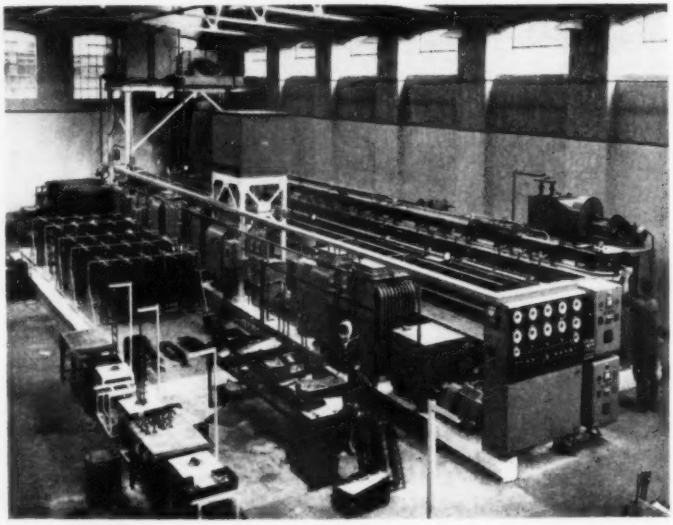


Fig. 1.—General view of the "Gem". The jig load/unload area is in the foreground. The hydraulic power unit for the plant together with its oil reservoir can be seen behind the master control panel.

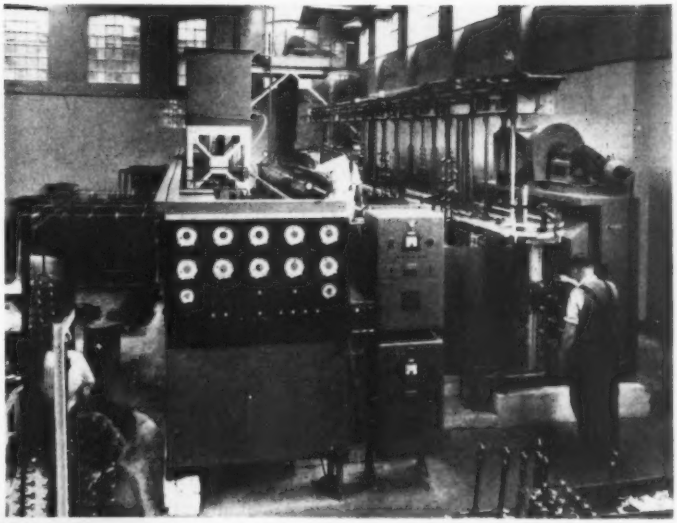


Fig. 2.—(right) The master control panel and constant current density control units. In the background is the main 'trunking' for the fume extraction system. The extraction fan and its motor are on the platform at the rear of the plant.

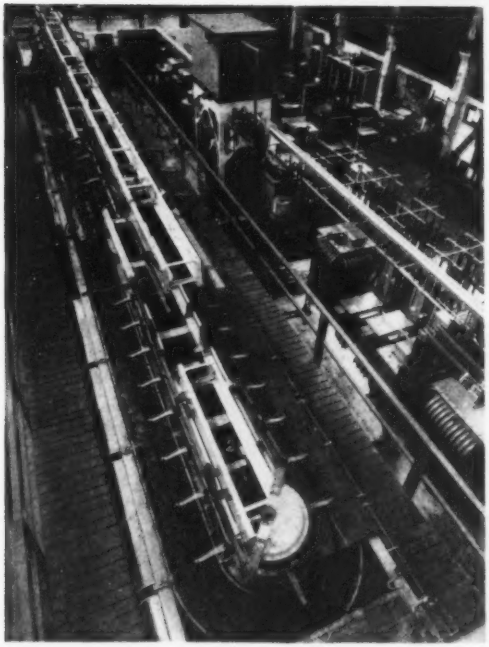


Fig. 3.—(below) Overhead view of "Gem" unit showing the U-shaped nickel plating section in the foreground. To the right are rectifiers, transformers and one of the "Sentinel" filter units.

These problems are resolved on this plant by continuous plating-out equipment which checks the level of metallic impurities in the solution and by continuous filtration which removes any solids in suspension. Filtration is carried out by "Sentinel" 2,000/1,000 g.p.h. units (See Fig. 3). These are totally-enclosed plate-type filters, the plates and cloths being made up into packs which can be quickly removed and dismantled for cleaning.

Chrome-recovery equipment is fitted to this plating installation. Dragout liquid is gravity fed into the recovery unit which is a lead-lined tank heated by a titanium coil. The liquor is heated to evaporate off water and when the required state of concentration is reached, the reclaimed chrome is pumped back into the plating tank.

In order to conserve water, swill tanks for most processes are arranged to operate on a counterflow system.

Fume extraction equipment is fitted to all appropriate tanks. This takes the form of a lip extraction system which draws fumes and steam from the surface of the solutions and feeds into underfloor ducts on either side of the installation, joining the main exhaust system at the end of the plant. Fumes are then drawn up through the main trunking by an extraction fan and discharged to atmosphere above the roof of the building. Current for the electrolytic cleaning and plating processes is provided by transformers and rectifiers which step down the 400/440-volt 3-phase supply to 6-12 volts d.c.

Push-button controls operate all ancillary equipment, such as pumps and filters, and pilot lights immediately indicate any fault in any part of the systems should it occur.

In addition to the obvious advantages of large outputs of uniformly plated work, the new plant makes possible greatly improved working conditions. Gone are the aprons and boots which have for so long been the uniform of the plater.

The installation of this automatic plant is one stage of several in Pegler's development programme.

FLOW-COAT LINE IMPROVES CORROSION PROTECTION

Boeing Introduce New Production System for the Protection of Jet-Aircraft Parts

THE Transport Division of Boeing Airplane Company in the United States has recently introduced a new production system in order to provide improved coatings for the protection of parts of jet aircrafts.

The new system called " Flow Coater," cleans, deoxidizes, anodizes, paints and dries a wide variety of parts for commercial jets, KC-135 tanker-transport and C-135 transports, providing improved quality in coated parts and more even coverage than hand-applied spray coats.

Protecting metals in aircraft began with paint, which was either brushed, sprayed or applied by immersion in a dip tank. Later parts were sprayed with epoxy-resin paint or zinc chromate, depending upon specifications and type of hydraulic fluid used near the parts. Epoxy, a synthesized, plastic-like material has the advantage of being resistant to Skydrol 500 hydraulic fluid, widely used in aircraft systems. The fluid would quickly strip parts of zinc-chromate coatings. But epoxy has a short pot life. It normally sets and becomes unusable in about eight hours. Thus, a 3,000-gallon dip-tank operation is not feasible.

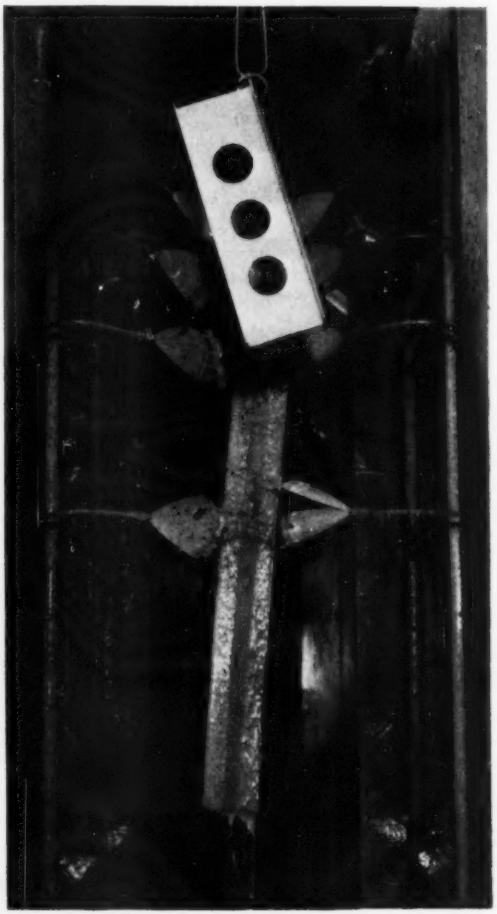
Specialists applied hand spraying ; batches of epoxy could be kept small to avoid waste. Two drawbacks, however, were difficulty in achieving uniform application, and time required to handle and dry parts in spray shops.

Company researchers knew that by lengthening pot life, they could substantially reduce spraying operations and increase shop efficiency. A new formula was obtained from a manufacturer which boosted pot life from 8 to 100 hours and led to the construction of the new flow-coat facility. (Boeing is the first among aero-space companies to use flow-coat techniques with epoxies that set at room temperatures.)

The new system will be used in protecting such parts as wing leading- and trailing-edge details, interior fuselage components and structural material inside the vertical stabilizer.

Key to the flow-coat operation is a battery of nozzles within a tunnel which houses most of the

Fig. 1.—*Jets of epoxy flood the parts with the coating. Excess is drained off, collected in a sump, cleared and recirculated through the system.*



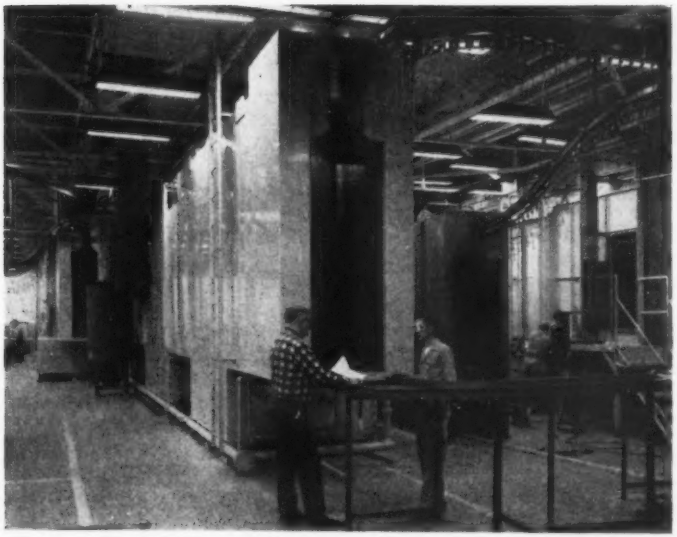


Fig. 2.—The conveyor has six thousand hooks travelling on an overhead monorails and can carry parts up to 4 by 6 by 1½ feet.

Fig. 3.—(below) The conveyor travels through a series of steel-walled tunnels, which house a number of process stages.

conveyor. Jets of epoxy stream from the nozzles, flooding parts with the coating. Excess epoxy drains off, is collected in a sump, cleaned and re-circulated through the system.

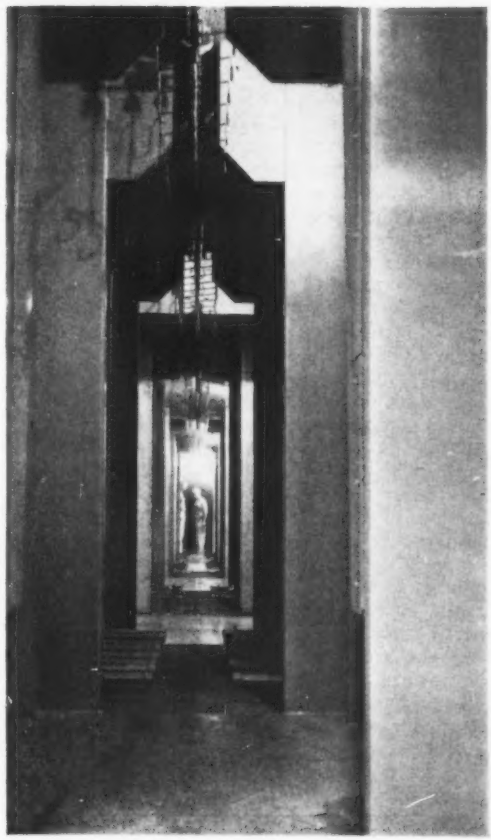
Six thousand hooks hang on the four-block-long overhead monorail. They move at 10 feet per minute and accept parts quickly and easily. Hooks are single-and triple-arm types, canted 20 degrees to facilitate observation from the loading platform.

The conveyor travels through a series of steel-walled tunnels. Parts with dimensions up to 4 by 6 by 1½ feet can be accommodated. In the first stage a hot alkaline cleaning shower drenches each part before entering a water rinsing process. Next the parts go into a deoxidizing chamber and emerge through another water rinse.

The chemical conversion chamber, next on the line, applies a yellow-brown chemical paint base to the part. Following this is another rinse, and the part passes through a dry-off oven to remove all moisture. It is then cooled in an air bath. This provides a dry-coated surface at room temperature.

In the coating chamber the nozzles spray the epoxy. The recycle system makes a 30-gallon reservoir do the same work as a 3,000 gallon dip tank.

The dry-off chamber is a vapour tunnel, where a controlled atmosphere of epoxy solvent helps determine depth of the coating. The concentration of vapours, together with the epoxy formula, determines the rate of coating runoff and thus thickness. Emerging from this area, parts proceed through an inspection station. Parts requiring touch-up are hand sprayed in this area. Last in line is the paint-drying room, from which finished parts emerge.



METAL FINISHING CONFERENCE

Llandudno May 2 to 6, 1961

A Report of the Annual Conference of of the Institute of Metal Finishing

(Continued from page 348 September issue 1961)

NEW DEVELOPMENTS IN PAINTING EQUIPMENT

by A. L. Newcomb*

THE paper discusses some of the major design trends and developments in conveying, pre-treatment plant, spray booths and paint stoving ovens.

A great number of automobile manufacturers are converting to the automated floor-skid method of conveying bodies through the paint shop. Several others who are constructing large volume systems are installing twin-line layout. This entails dividing the production into two lines working at half the speed of a single line in an effort to improve quality and reduce costs through fewer rejects. Another trend among manufacturers is to switch to floor-type conveyors through phosphating units to minimize contaminating droplets from overhead.

A few years ago, the inverted pyramid bottom was developed for phosphating tanks and as experience was gained, the angle of slope was increased in an effort to keep the sludge from arching up at the lower end of the inverted pyramids. On the larger systems continuous desludging arrangement may now be installed, in which the sludge is continually circulated from the bottom of the pyramids through piping and a small pump, to band filters at the top of the phosphating enclosure. Sludge is deposited on the moving paper filter and cleaned solution drains back into the tank.

Several of these systems are operating very successfully in Europe and require pumping into the transfer tank only a few times a year for inspection. Perhaps the most important minor improvement that assures success of this desludging system is the development of ramrod type sludge agitators located in the elbow fittings at the base of the inverted pyramids. These ramrods are operated manually at short intervals, several times a day and keep the ends of the pyramids free from obstructions.

Several manufacturers are investigating the full plunge dip for primer coats in an effort to improve paint coverage and reduce costs, while others are installing down-draught type spray booths with washer sections directly below the spray tunnel in the basement and claim several advantages for this arrangement.

Some manufacturers are providing for conversion of the new spray booths from manual to electrostatic spraying in the future, to ensure adaption of the booths to the process. The installation of radiant wall type of heating in the paint stoving ovens is being undertaken by many manufacturers in an effort to obtain more uniformity of metal temperatures and improve the final finish.

The author concludes by saying that as a result of these design features new car-body shops should strengthen their link in the chain of assembly operations.

*President, Newcomb-Detroit Co.

THE SELECTION OF FINISHES FOR PROTECTION AND DECORATION IN THE AUTOMOBILE INDUSTRY

by R. J. Brown*

THIS paper discusses the underlying requirement for the appropriate type of finish, whether it is applied for the purpose of corrosion protection alone, or for the combined purpose of protecting against corrosion and for decoration.

Consideration is given to temporary and semi-permanent corrosion protectives, and the need for their complete removal if permanent coatings are to be subsequently applied. Permanent corrosion protection results from the combination of formulation of the coating and its thickness in the case of organic finishes, and the choice of such finishes is related to their location and to the method of application.

The need for adequate pre-treatment is stressed, and reference made to the claims made for zinc-coated sheet steel as a material for motor-car construction.

The advent of clad materials is briefly considered, together with the relative merits of electro-deposition as a method of achieving a decorative finish in comparison with the claims made for competitive materials such as stainless iron, brightened and anodized aluminium, and plastics.

*British Motor Corp.

With such an extremely broad subject, the author has not been able to deal adequately with the many technical reasons for the selection of the diverse finishes used by the motor industry, but an endeavour has been made to present a fair picture of the main finish requirements and of the type of materials chosen to fulfill the extremely arduous conditions to which motor vehicles are subjected.

DISCUSSION

MR. I. G. F. WALKER (Ford Motor Co.) said that it was now, two years and half a million vehicles ago since a large paint shop with which he was associated had been planned. Already, in many respects, it was out of date. This would give some indication of the rate of development.

He had been particularly interested in the new down-draught type spray booth with " washers in the basement," shown in Fig. 7. He would like to hear whether the new design would eliminate one of the present weaknesses of designs which seemed to allow far too much paint to be deposited on the factory roof and on motor vehicles parked too near the building. It was a serious problem for manufacturers and designers. Impressive statements concerning washing down to so many grains per 1000 cu. ft. did not mean much when millions of cu. ft. were being exhausted. A considerable improvement was required.

The author referred to ramrod-type sludge agitators at the base of the inverted pyramids of phosphating tanks. During the past two years these had caused agitation among the maintenance men at his own organization — so much so that they had now been removed. They had not coped effectively with hard scale from the heating coils, as well as loose metallic objects, which even skilled fitters sometimes dropped into the tanks. The maintenance men had replaced the ramrod agitator with a false bottom, separated by a valve normally open, and had attached a pipe at right-angles through which compressed air could be blown to loosen the sludge. At regular intervals the false bottom chamber was isolated from the main tank and emptied of loose nuts, bolts and hard scale which could not be pumped to the band filter.

The need for an efficient denaturing compound had been stressed — so that one could deal with paint spray in the exhaust air. When plant designers had to rely on magical chemicals to get them out of their difficulties the finger should perhaps be pointing somewhere else. He did not believe in magic chemicals ! The effective removal of paint spray was a problem with all spray booths so far developed, and the motor trade looked with interest and hope to the new booth shown in the drawing to be seen in the exhibition room of the conference. He still felt that booth designers should think very seriously about it.

He would query the need for a walkway in the *slipper* dip tank arrangement. It had a handrail and lights and was good enough for visitors to use. He might sometimes wish that plan designers could be led into his own organisation's *slipper* dip tunnel but he would not wish it even for their most awkward suppliers.

They had always attempted to maintain a reasonably high solvent concentration to assist the flow of the paint and would be interested to hear the reason for the development ; or was it that water-thinned paint was being used ? Of more importance was the foam shown on the surface of the paint in the tank. Although it helped the photography, its presence was not compatible with obtaining a clean even drain of paint from the outside of the bodies.

Paint designors did not yet appear to appreciate the need for a sufficiently high rate of paint circulation to overcome this fault. Although the past few years had shown a considerable improvement in ovens he would not like plant designers to feel complacent. Radiant wall heating systems had been mentioned. Had the author any evidence to confirm that they gave better results ?

MR. E. C. J. FRY, said that Mr. Brown had placed some emphasis on temporary protection. This aspect seemed to have been somewhat neglected in the past. His many references to p.v.c.-clad material were of especial interest. The paint industry had always to look very much to the future, so he proposed to speculate a little on this development.

Water-Based Finishes

In general, if the motor car industry was to continue demanding finishes and corrosion protection with longer life it would be necessary to pass from alkyds and the minor resins to long-chain polymers of some sort. One of the most significant things about the introduction of water-based finishes in the United States had been neither the point about the famous fire of 1954, nor odour, nor even price. If one used an emulsion type of primer, for example, it was a convenient way of putting on a highly polymeric material in the sort of film thickness and with the kind of process normally used. Dispersion finishes of the organosol type might play a big part in the future, not necessarily for finishes but certainly for corrosion protection.

The big disadvantage of pre-clad materials was, of course, the edge protection. Unless one used aluminium in great quantities he did not see how this could be completely overcome. There was also the difficulty of welding to be considered; but if one could put the same type of protection on

after the body was made — and here he was thinking of plastisol, organosol etc., which could now be spread and stoved at civilized temperatures and for civilized times — one might make a big step forward. Would the author be so kind as to respond to these speculations and say whether he thought the water-based primer would come in ? Could he comment on the prospects for emulsion types versus solution types ? Did he think that materials dispersion types, such as the organosols, or dispersions of other polymers, might be coming along in the next five years or so ?

Acrylic Finishes

Could the author amplify his remarks about acrylic finishes. He would apologise for emphasising the nature of the materials. There were drawbacks to acrylic finishes, but they had taken hold to a very large extent in the United States. A most interesting feature of this was the rapidity with which General Motors had gone over to an air drying type of acrylic lacquer. Would the author substantiate his somewhat derogatory remarks about these finishes in the paper ?

DR. T. P. HOAR (University of Cambridge) said that Mr. Brown had said nothing about the way in which he would assess an organic system of finishing on the edges and on the corners of sheets. In a paper which he had himself given to the Automobile Section of the Institution of Mechanical Engineers three years earlier he had pointed out that the finishing of flat or nearly flat material organically was almost a solved problem. It was easy to make an organic coating that would last the lifetime of a car, but this was not equally true for edges, corners, crevices and re-entrant parts. This was where the user found chipping occurring. The coating was either too thick or too thin. What methods were adopted to alleviate this problem, and what was the future likely to bring here ? Would we have a car on which the edges of the doors remained in good condition for five or six years, as did the flat parts ?

So far as the latter were concerned there was always, in his experience, a certain amount of orange peel effect on the body.

Turning to nickel-chrome plating and its various competitors, were the present large motor cars in the ordinary modest range made according to the severe service specification laid down by the British Standard which had come out in the last year or so and if not, why not ? What progress had been made in putting a really good nickel-based plate on zinc diecasting such as could be left out in the open for 18 months or so without pustules developing ?

Chromizing

The author had not mentioned chromizing and some other forms of protection in regard to silencers and similar gear, which became hot in service. Shortly he would himself be inspecting a new system for making a silencer that was quaranteed to last for as long as the transmission of the car lasted, and this was, of course, the length of time it should last.

DR. S. WERNICK (Hon. Secretary) said that the reference to orange peel reminded him of the authenticated story of the American car manufacturer who, many years earlier, had made a virtue of necessity and had advertised that he produced a paint finish that was non-reflecting. It was an orange peel finish. He was glad to hear Mr. Newcomb's comment on the *Rotodip*, a British development of long standing. Ten years before, when lecturing in Detroit on British metal finishing advances, he had shown a film of the *Rotodip* process, and it had aroused much interest. Many American technicians had said that it should be taken up by manufacturers. It had not been and he was wondering why. Since then American manufacturers had become extremely rust-conscious particularly where underbody parts were concerned, and had gone to extraordinary lengths to counter it. They now used galvanized steel on such components, despite the obvious additional cost. Perhaps one could have the best of both worlds by employing a combination of zinc, electro-zinc or galvanized steel plus *Rotodip*. The only drawback would be that of expense.

Mr. Brown had referred to sprayed aluminium. In the United States where great attention was being paid to silencers corroding, and dropping off, aluminized steel had very largely been adopted. The advantage of the finish was that one had an integral coating of the aluminium and the steel.

In regard to chromizing, more recently an American company had taken up vitreous enamelling of silencers. He had seen zinc-rich paints applied in American car plants. Also, they had used galvanized steel. They seemed to have overcome the welding problems.

MR. T. C. TAPP, in a written contribution relating to Mr. Brown's paper, agreed with the author on the importance of absolute cleanliness as the first stage of any finishing process for a metal surface.

The problem had been tackled in different ways on the two sides of the Atlantic. Americans had turned to galvanized construction for part of the underbody. In Great Britain some firms preferred an electro-zinc coated sheet. Others still relied on pre-treatment and a good quality paint, but the world trend was moving towards a strip mill coated sheet. Plants such as had been operated in Britain

since the war had recently been started up now in Belgium, France and Japan, with Germany next on the list. The plants were all basically the same, producing for similar markets and with the same end object — lengthening the life of the fabricated steel sheet.

MR. I. G. F. WALKER (Ford Motor Co.) said that the main problem in the use of zinc-coated steel was protection against corrosion from inside the channels, not outside. It occurred much more rapidly there. In passing, he might add that this was perhaps a good reason for not applying underseal to the bottom of one's car. He would like the author's comments on this. Could it not be a dangerous practice, in that it would accelerate the corrosion from within the channels, while lessening it from the outside ? Even Chrysler and Ford, who were dip painting, used, in addition, zinc-coated steel. Could Mr. Brown give the results of examinations that he must have conducted on vehicles that had been under corrosive conditions for some years ? He was referring here to vehicles that had been both slipper dipped and Rotodipped. Did he not feel that this protection was a good thing ? His own organization felt that, as corrosive conditions in the world were becoming more severe, it was necessary to zinc-coat as well and use the phosphating and slipper-dip processes.

Welding Problems Overcome

Welding problems could indeed be overcome. It meant a 20 per cent. increase in time, and an increase in current density. One had also to put in sufficient presses to compensate for the reduced production rate. Their own experience had been that zinc-coated spot-welded steel gave adequate protection in that there was still an adequate zinc layer around the area of the spot weld.

Something that was lost sight of by people who advocated the use of more p.v.c. coated materials in motor car manufacture was the fact that a large proportion (about 40 per cent.) of the steel used became scrap, and if raw material cost went up it increased considerably the cost of the component.

MR. D. H. GROVER (Cellon Ltd.) said that Mr. Newcomb, in referring to an electrostatic system designed around the hot spray process had said that " the charged combination of the 360 deg. spray gun and paint heater together with the use of hot ionized atomizing air seemed to give a new unexpected effect in electrostatic painting, and appears to make the standard formulations of paint, including the new water-based paints, more usable for electrostatic spray painting." He would like to sound a note of warning here. While agreeing that electrostatic spray painting was now going out of the art and alchemy stage one of the most important aspects of all was control of the electrical resistance of the paint.

Water-based paints would produce a severe sludging problem. With organically-based materials it was a matter of separating from water whereas the water-based paints, having infinite dilution, produced a reverse problem, that of coagulation, so that one could carry out removal and return the water to the washing plants.

Electrostatic Spraying in Sweden

MR. J. N. T. ADCOCK (I.C.I.) sought further information on the method of electrostatic spraying developed in Sweden. How did it compare with a type of hand electrostatic gun which had appeared on the English market recently ? In this the paint was atomized partly by centrifugal force, enabling one to get into crevices rather more easily than had previous types. As far as one could judge, it was not nearly so susceptible to polar and non-polar solvents.

Authors' Reply

MR. A. NEWCOMB, replying, said that the down-draught type's washer arrangement was probably more efficient than that of any of the booths with which he was familiar. The efficiency figure was about 99.5 per cent. Greater efficiency demanded higher horsepower and more expensive equipment. The design of the " Venturis " was based on a tried and proven principle applied in air washing in many industries. A performance figure of 99.7 per cent. could be reached by them without great difficulty, so he felt that the quantity of pigment going out to stack was substantially reduced.

The ramrods at the base of the inverted pyramids of the sludging system were not 100 per cent. efficient but were better than what had offered previously. He was glad to hear that an improvement upon them had been made in Britain.

There was a wide range of efficiency in the different spray booth compounds. In the paper he had referred to some primary laboratory tests that sorted them out. It was simply a matter of adapting a commercial compound, or something one might develop domestically, to individual problems.

So far as the walkway for the slipper dip process was concerned, he believed that maintenance men should have every opportunity to clean equipment. The walkway was very necessary. He had seen workers' hats, gloves and shoes floating in the tanks. Recently someone had even found a dead duck !

A great deal of time and effort had been directed towards the study of metal temperatures in motor bodies. The chart that he had shown was the best that he had seen. He had seen some rather wild ones, so far as the break-up of time of underbody temperatures to top-of-body temperatures was concerned. He was glad to see being developed

a package size instrument that can be put in an automobile body, run through with it in production, and come up with some metal temperature answers.

Comparisons between radiant wall heating and convection heating seemed to suggest that as the former produced less air agitation, and therefore less likelihood of dust, it was doing good work in bringing about more uniform temperatures as between the bottom and the top of the body. There was more accent now on metal temperatures in connection with body finishing than there had been in the past.

The Rotodip certainly accomplished, he said, what it started out to do. However, if the German dip coated all surfaces satisfactorily it would probably do the work for a fifth of the price.

The Swedish electrostatic spraying method he had described was attracting great interest. It used the standard gun and a paint heater, the latter heating the air rather than the water. The heated paint went into the gun and was used in atomizing. The gun and the heat exchanger could be charged. The gun threw a 360 deg. pattern. There was a secondary area which could be controlled from outside the booth.

He had based his remarks about the better possibilities with water-based paint on conversations with paint manufacturers in Germany. They had not said that they would use the same formulations but had admitted that the situation approached this. They were continuing to experiment. One of the largest automobile manufacturers in Sweden was setting up a test unit using the hot spray process.

MR. R. J. BROWN, replying, said that he could reply to 75 per cent. of the questions raised by referring to the element of cost. However, this would not be fair because, as a branch of the motor industry, they were not cost conscious to the point that they ignored what happened to the vehicle. Their aim was obviously to produce vehicles which were value for a given price. If cost were of no consequence, however, one could extend the life of a vehicle considerably. In their factory they regarded it as good housekeeping to insist that one could not finish a material satisfactorily unless it was received in a rust-free state.

They were, naturally, most interested in water-based paints, and were constantly investigating them. At the moment they did not regard them highly, having in mind their price.

In regard to the use of preliminary coatings of greater thickness — the organosols in particular — here again cost was the deciding factor. As soon as these things could be used at reasonable cost they would be. They were as anxious as was the customer that satisfaction should be given. It had been suggested that if the organosol could be applied to the completed body, rather than building up from a pre-coated sheet, one would get overall protection. This was quite true, but it would be extremely costly.

Their experience with acrylic finishes had been mainly on a development scale, with a view to seeing how they behaved. He felt that in the United States they had been used largely because they produced the finish needed at a reasonable price and had given reasonable life for that market. In the United States there was a very thriving re-finishing trade. No-one worried greatly if his car had to be re-finished, but in this country any car owner whose car needed re-finishing under ten years expected to have it done free. He complained even about minor defects during the first two years.

He could see no solution of the edge coating difficulty. The physics of the problem were such that one was bound to have the danger of chipping on the edges of a flat sheet. In any case, the stress system in the coating must be such that the adhesive forces were reduced. Dr. Hoar had asked whether a finish could be given which would last for five years on, say, a car door. At present the finish given should last for ten years, but no-one could guarantee that it would last this long if doors were opened against brick walls, for instance.

Orange peel effect was not produced intentionally, or from any wish to mask defects. Any worthwhile paint finisher was anxious to produce an orange peel-free and ripple-free surface. The same plant, using the same process, produced a diversity of surface textures, depending on the pigmentation of the paint. British Standard specifications were observed. Zinc diecastings were a case in point. All plating on motor cars had shown a great improvement over the past three or four years.

Cost put the chromizing of silencers out of bounds. This was equally true of aluminized steel and vitreous enamelled finishes. The average silencer lasted something like 20,000 miles and, as the replacement cost was only about £5, including labour, the customer had little to grumble about.

On the question of whether with electrodeposited or galvanized sheet phosphate treatment was essential to keep the paint of the zinc coating, a zinc-coated kitchen unit in his own home had given appallingly low performance, and after four or five years service was in a shocking state.

It had never occurred to him that undersealing might hasten corrosion of interior surfaces. They had always endeavoured, in the floor sections, to provide sufficient ventilation to discharge the effects of condensation. This was essential, but it was often overlooked by designers. Better ventilation gave much longer life.

THE USE AND VALUE OF LABORATORY TESTS OF THE DURABILITY OF PAINT COATINGS

by J. A. W. van Laar*

THIS paper describes some simple tests by which the reactions of a painted cold-rolled steel panel under certain mechanical and climatic influences can be determined. The tests are not meant primarily to imitate the complex and various influences to which a painted article is subjected in practice but to illustrate the result of certain influences.

The most important feature of these tests is that they should be reproducible and give quantitative results that can be readily communicated. The author describes the following mechanical tests :

1) Indentation, using a Vickers pyramid with a specified load for a defined time.
2) The paint surface removed by a number of standard nuts falling from a fixed height.
3) The effect of a standard stylus which removes the paint completely and the width of track measured.

The indentation tests represents the application of a force too small to create permanent damage but indicating how the film would react to small long-term forces and the ease with which damage might be initiated. The falling nut test shows the effect of forces sufficiently large to cause limited damage to the film and which are associated with considerable shock loading. The scratch test is the application of a force sufficiently great to inflict damage along a line of its own direction, but of a severely local nature.

The measurement of the film reaction to the conditions of the tests should enable the designer of an organic finishing system to select materials and treatments to reduce the harmful effects of such indents to a minimum. Typically the scratch test should enable a finishing system to be selected which will keep damage from a metal point such as a nail to the minimum. The pyramid identation test allows the selection of a system whose hardness will resist the initial penetration of such an object. Other tests used for the same purpose are bend tests, abrasion tests and elongation of both free films and those on a substrate.

A mechanism is also suggested in the paper for the changes observed in three environment tests, and a pure water immersion test is described.

An underrust test is described in which the samples are kept at a constant relative humidity below 90 per cent. and standard conditions produced by dosing with the stimulant in practice.

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SELECTION AND TESTING OF FINISHES FOR DOMESTIC APPLIANCES

by R. Warburton*

THE author reviews the subject against the background of the domestic appliance industry as it has developed during the past years.

The basic requirement of all domestic appliances is that they must be suitable for the purpose intended and attain a standard of manufacture and finish expected by the consumer.

The paper is concerned mainly with organic coatings and in this field paints are taken as the best illustration of what goes into their selection and testing by the appliance manufacturer for use on his products.

The standard of finish on the products depends on many factors besides the performance of the paint itself. Highly mechanized plants are used and certain of the operations, which require fairly fine control, may deviate with out the fact being visible to the inspector. For instance the film thickness on some region of a cabinet may fall below the optimum and thus some form of quality control testing of the painted product will keep such things under review. A satisfactory method is to take a finished painted component and subject it to some or all of the tests used for the original evaluation of the material. Testing in this way is a good method of ensuring the consistent behaviour of the plant both for pre-treatment, paint application, stoving etc.

Such testing, however, being destructive, cannot be used too often or too widely and in any case is retrospective. However, as there is so little that can be done in the way of non-destructive tests in the paint shop at the time of inspecting the product, this form of quality control is probably the best answer.

In the long run the performance of paints is judged by their behaviour on the product in service, and thus comments from users are carefully studied.

Probably the most dramatic recent development in finishing has been the development in acrylic enamels. It is still early days but there are indications that these enamels will have the very high performance needed in the appliance industry and at the same time their characteristics will allow coating in one operation. The advantages of obtaining a high performance finish in one operation with consequent lowering of application costs and capital investment in plant are obvious.

In the opinion of the author, painted steel will hold its place for a long time as the best proposition open to the appliance manufacturer for housing and cladding his products, as it enables him to give to the consumer a high quality product at the best price. Steel appeals to the manufacturer

*A.E.I. Hotpoint Ltd.

because there are a great many well understood and highly developed techniques available for fabricating and forming it. Here is probably the greatest challenge from the appliances industry to continue its search for and development of materials which will maintain the quality of the product but at the same time improve the cost both by cheaper finishing materials and simpler processing methods.

DISCUSSION

MR. R. L. YEATES (Docker Bros.) said that the falling nuts test rather reminded him of an occasion when he had been motoring on dirt roads in Sweden and his car had been showered with stones. He wondered whether there was any correlation between the nut fall test and the effects produced on the paint work on that occasion ! The details of the test had struck him as complicated and time-consuming. He was thinking of the preparation of the nuts etc. Could Mr. van Laar really assess his results quantitatively ? Was the actual result obtained by any use ?

The author attached much importance to the scratch test but could all the deductions be justified ? He did not know whether the author had the same idea of blistering as he had. Most of his own experience had been in regard to osmotic blistering rather than rust-creep. Reversible blistering had been mentioned. Did the author refer to the effect of an incipient blister which dried out and was not seen the next time ? He had said that the incidence of blistering was always on the metal interface. Some of his own colleagues had had experience of inter-coat blistering.

After hearing at Detroit the previous year a paper on the texture of metal surfaces he felt that he knew nothing about it, but he also had a feeling that electromagnetic instruments were not of sufficient accuracy to measure texture in the way described.

A film thickness of 0.005 in. on structural steel was acceptable, but on a car body 0.002 in. was rather too little.

MR. D. H. GROVER (Cellon Ltd.) said that the Institute had also gone to the trouble to publish a booklet on design in order to emphasize the importance of this at an early stage. On the organic side, especially in regard to yellowing, detergent resistance and the general stability of the coating for domestic use the changes had been even more marked. Surface hardness had been raised from a 2H pencil hardness to about 6H and was rapidly approaching vitreous standard. Flexibility in such a common domestic article as the tooth paste tube had reached an extremely high point. Resistance to chemical attack had been increased twenty-fold in some cases. All were relevant to the domestic appliance industry because upgrading in quality without a tangible increase in cost of production was the vital part the industry had to play.

Discipline in Production

If one wanted maximum performance from an organic coating a much higher standard of discipline in production was necessary. There were certain limits that one could not exceed. New methods often required capital investment on a large scale, and this had to be amortized over a reasonable quantity of production. With the best will in the world, the new development that was a "must" could not always be introduced economically.

Mr. Warburton had emphasized, almost in the first breath as it were, that when a new technique was introduced the actual method of application must be promulgated throughout the trade, so that from the beginning there was no opportunity for people not to discuss the way in which it should be done. Secondly, he had pointed out that it was not necessarily the organic coating with the highest possible performance that was best for the job. One had to strike a mean, relating cost to ease of production. This usually added up to the right choice. Third, his conviction that destructive tests combined with assessment of finish relative to that at present enjoyed by the consumer was the best method, was interesting. It negated the tendency of certain industries to draw up extremely complicated specifications calling for performance or even composition clauses in the hope that this would produce the best organic coatings for the job. The more flexible method suggested had much to commend it. However, the author had not indicated what material he considered best.

No doubt the primary choice would be steel. Would the author comment on phosphate or zinc-coated steel *vis-a-vis* the electro-treated sheet ? One of the major purposes of attempting to produce a one-coat finish was the obvious one of cost — not at the expense of the consumer but to increase the consumer market. This raised the question of whether it was really necessary to paint the interior of machines. Was there any real corrosion problem which could not be solved further down the line ?

MR. M. J. REIDT (Metal Research Institute, T.N.O., Holland) said that many steel articles for household appliances were now base phosphated before painting and lacquering. The supply houses for phosphating claimed that corrosion resistance and adhesion, in particular, were improved. However, the mechanical properties of a paint film on phosphate and steel were to a certain extent dependent on the method of pre-treatment before phosphating.

Importance of Erichsen Test

The paper contained no information about the Erichsen test, but with this test it was possible to get an impression of the mechanical properties, and, in a way, about the adherence and bonding of the paint film to the base material. One disadvantage of the test was that a combination of properties was determined at one and the same time ; another that the test was done in the opposite way to what might be expected in practice. In phosphating, the cleaning and pickling operation had a considerable influence on the crystal size of the coating. Certain cleaning and pickling operations resulted in a low Erichsen figure. One could have a slightly different value, for instance, if one was pickling in hydrochloric acid as distinct from, say, phosphoric acid.

One of the difficulties with steel was that often cold-rolled steel, delivered in a splendid condition, began rusting somewhere in the middle of the production process. On the previous day he had been shown several examples of such material. It had been described as coming from the continent. As he was a guest of Britain at the moment he would not pursue this question !

Paint manufacturers were never interested in pre-treatment of the base material, leaving this to the users of the paint and to the suppliers of the phosphating solutions. The suppliers had not a great deal of experience in the testing of paint films and he felt that the Erichsen test might be the missing link in this respect.

MR. I. WALKER (Ford Motor Co.) asked Mr. Van Laar whether he considered his falling nuts test sufficient to determine the amount of adhesion between two coats.

Filiform Corrosion

MR. D. H. GROVER (Cellon Ltd.) said that Mr. van Larr's paper was important because for the first time some clear light had been thrown on the corrosion question. His own belief was that with deep-drawing cold-rolled steel a good deal of uniform filiform corrosion was caused in an electrochemical way. An acid pickle seemed to reduce it to a minimum. Phosphating only delayed its onslaught, as did sheer weight of paint. Could the author give any relationship between paint film thickness and the time at which filiform corrosion occurred ? Had he any evidence of its relationship to the water permeability of the organic coatings used ? This work was very important as many specifications up and down the country involved the use of techniques which called for 100 per cent. humidity. The author had shown that if one dropped the humidity below 96 per cent. one got an entirely different set of test data, and interpretation.

MR. E. C. J. FRY said that recently it had been suggested that an important reason why laboratory tests did not correlate with exterior exposure was that in the latter one got a very random succession of agents operating, e.g., pure water, water containing various acids and so on, and these varied from time to time. It had also been suggested that one might devise a test which incorporated to some extent a random succession of agents. The ordinary weathering test simply did not do this. In view of the complicated nature of the paint film it seemed feasible that it was this which made most accelerated exposure work in the laboratory rather fruitless.

Plastics had found their way to a great extent into appliance construction, *e.g.*, interior liners for refrigerators. What was Mr. Warburton's opinion about how fast this kind of development was occurring, and as to whether one could put any credance in the suggestion that even a sandwich-type construction, using plastic with rigid form in between, could be used for refrigerators and other appliances ?

Authors' Reply

MR. J. A. W. VAN LAAR, replying, said each falling nut test took only a few tenths of a second ; one could carry out the test four times in only a few seconds. Pretreatment was necessary before the first test, but never thereafter. The test was done quantitatively. One put a square of translucent graph paper on the panel and could measure the amount of paint removed. The fact that he had been able to find a statistician to analyse the results proved that it was practicable.

There were many forms of blistering. Blisters occurred preferentially along the scratches. The subject was discussed in many papers, including one of his own which was published in 1959. Blistering which was influenced by atomic hydrogen, was a very complicated matter and it was not possible to make a systematic division. Blisters were sometimes reversible, if the electrical charge to the film went through zero. The sign of the film was usually negative. The water was positive and drawn to the cathodic parts. If the sign were reversed the water would go to the anodic parts, the blisters would dry out and others would come into existence.

There was a lack of adhesion between several layers of paint in group IV 2, so he would agree that this did sometimes occur. It could be detected by the falling nuts test.

A roughness of 0.001 in. was measurable by the three thickness instruments, including the Elcometer and a film paint coat thickness of 0.002 in. was not too little for a car body. He would not agree with what had been said about the Erichsen

(*Continued in page* 426)

I.M.F. CONFERENCE

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The future name of the Belgian company will be Johnson Matthey and Pauwels S.A. Mr. H. Limbourg, hitherto general manager, becomes managing director, and Mr. L. Mendel the general manager, while Mr. R. Turner and Mr. P. G. Smyrk (directors of Johnson Matthey) join the board of the Belgian company.

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ALBRIGHT and WILSON GROUP EXPAND

Port Maitland Plant in Operation

THE Electric Reduction Company of Canada Ltd.—a member of the Albright and Wilson Group—have started production at their new multi-million dollar plant at Port Maitland, Ontario. Initial production is aimed at the agricultural industry and consists of normal and triple superphosphates, phosphoric acid and liquid phosphatics for use in fetilizers ; dicalcium phosphates for animal feed.

President of the Electric Reduction Co. of Canada Ltd., is Dr. D. E. Jones, who was born in Swansea, South Wales, in October, 1909. Dr. Jones joined Albright and Wilson in 1935 as a research chemist at their Oldbury factory. He was promoted assistant works manager of the Widnes factory in 1937 and the following year was appointed works manager. In 1945 he was made general manager of both the Kirkby and Widnes plants of the Group.

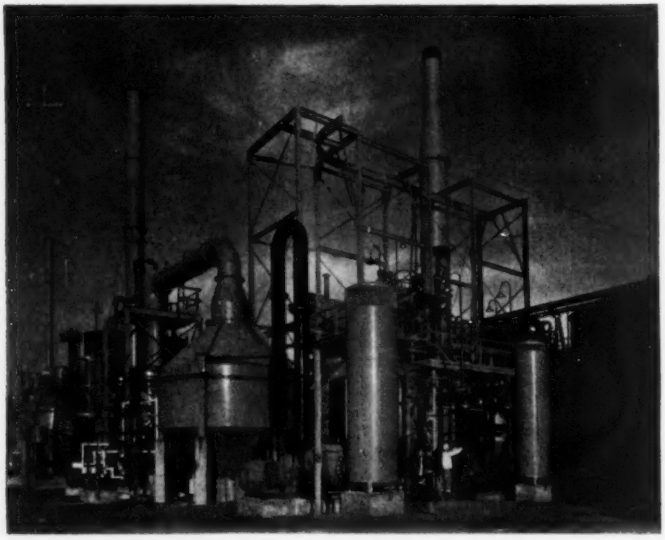
Dr. Jones moved to Canada in 1953 as president and managing director of the Electric Reduction Company of Canada Ltd. Since that time the number of employees has doubled and the sales have increased by 350 per cent. Dr. Jones is vice-chairman of the Society of Chemical Industry of Canada.

The new plant makes the Company one of the few producers of phosphatic fertilizers in an area at present consuming 750,000 tons each year, most of which was previously imported. The relatively high capacity of the Port Maitland plant places the company in a strong selling position. Up to 500,000 tons of phosphate rock will be transported by rail to the site each year. Another advantage of the plant is its extensive storage facilities which allow up to 50,000 tons of superphosphates alone to be held in stock.

A promising outlet for the production of the new plant is the animal food business, since about 30,000 tons of phosphates are imported into Canada each year for this purpose. Dicalcium phosphate, though competing with defluorinated phosphate rock and Curacao rock, provides the most available form of inorganic phosphorus for livestock food and should account for a major portion of the market.

The United States market is rich in potential and an entry has been facilitated by an agreement with International Minerals and Chemicals which provides for IMC handling ERCO material in return for supplying phosphate rock. It is anticipated that at least 25,000 tons of P_2O_5 in the form of high-analysis phosphates will be directed to the North Central United States.

A general view of plant for the concentration of phosphoric acid.



Dr. D. E. Jones

The integrated nature of the Port Maitland operations enable ERCO to alter its product mix to suit market conditions.

The Process :

Briefly, phosphate rock, which currently comes from Florida in rail cars, is ground and reacted with sulphuric acid piped from the adjacent plant of the Sherbrooke Metallurgical Co., a subsidiary of the United States company, Matthiessen and Hegler Zinc Co. It is then filtered and the precipitated gypsum discharged to waste. This is being done in a Prayon plant and produces weak wet phosphoric acid (about 30 per cent P_2O_5 content).

The acid is then concentrated to 54 per cent P_2O_5 content by an Ozark-Mahoning submerged burner acid concentrator. At this stage the acid is reacted with ground phosphate rock to produce triple superphosphate.

Using a clarification process developed by ERCO, part of the concentrated acid is prepared for shipment in rail tank cars as phosphatic fertilizer solution, mainly to the northern United States.

In the case of dicalcium phosphate, a mineral supplement for stock foods, a defluorination technique is employed prior to reacting the acid with ground limestone. The DCP process was developed by ERCO's own personnel.

Co-operation has been received from other companies in the Albright and Wilson Group, particularly in the field of wet acid and ultimate planning for industrial phosphates production.

NICKEL PLATING - FOUR A & W ADVANCES

WHATEVER YOUR NICKEL PLATING PROBLEMS—A & W HAVE AN ANSWER THAT'S RIGHT FOR YOU!

PLUSBRITE NICKEL plating bath. Combines the seven major requirements for effective bright nickel deposits.

☐ Low costs ☐ Fully bright deposits of excellent colour ☐ Excellent levelling properties ☐ High ductility ☐ Good receptivity to chromium plating ☐ Rapid plating ☐ Easy control

SBSF—for semi-bright nickel plating at high speed, a stable, sulphur-free addition agent which gives the bath very good levelling characteristics. This semi-bright deposit is intended for use with Plusbrite nickel and is part of an excellent duplex system.
It is also useful as a fast-plating, semi-bright solution.

PLUSBRITE DUPLEX—is for use where excellent corrosion resistance and maximum ductility is required with a fully bright finish.
The addition agents do not produce harmful breakdown products and are not removed by continuous filtration through carbon.

NICKEL SULPHAMATE—provides a bath for rapid plating of heavy nickel deposits, with superior ductility and low internal stress. It is used in the production of gramophone record stampers, in electroforming, in the re-sizing of worn parts and in facing of stereos and electrotypes.

TURN PAGE FOR IMPORTANT NEWS ABOUT COPPER PLATING

COPPER PLATING - OUTSTANDING NEW PROCESS DEVELOPED BY A&W

PYROBRITE BATH WITH PY-61C MAKES FINISHING UNNECESSARY!

The new PYROBRITE bath with addition agent PY-61C was developed by Albright & Wilson's own chemists. It is a significant advance over all previous copper-plating methods, and has been proved in commercial practice □ Albright & Wilson's PYROBRITE bath, based on pyrophosphates, is less toxic than conventional cyanide baths and much higher plating rates are possible. It has outstandingly good levelling characteristics, is easy to control and produces fully bright, close-grained, smooth deposits which will not fingermark or spot out □ The PYROBRITE copper bath is used for decorative plating, particularly as an undercoat on steel and zinc alloy diecastings before nickel and chromium plating, and for electroforming.

Mr. M. R. Steward has been appointed general manager of **Coates Bros. Paints Ltd.,** Crittall's Corner, Sidcup, Kent. Mr. Steward joined Coates Brothers and Co. Ltd., the parent company, in 1959 as a graduate trainee manager, and following technical training in the Resin Research Laboratory and in the paint formulation and metal coatings sections, was appointed production manager at the Sidcup paint factory, and later assistant general manager.

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B.B. Chemical Co. Ltd., Leicester (the BOSTIK people) announce the appointment of Dr. T. P. Hughes as joint assistant managing director. Dr. Hughes joins the firm from Tube Investments Ltd., where he had led the new research laboratories since the end of 1955.

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Mr. Sidney, H. Ireland, B.Sc., B.Com., has been appointed managing director of **Consolidated Pneumatic Tool Co. Ltd.,** 232, Dawes Road, London, S.W.6., in succession to Mr. Norman Readman, who becomes chairman of the board.

Mr. Ireland, joined Consolidated Pneumatic at the beginning of 1960 as assistant managing director.

VIBRATORY METAL FINISHING

SOME interesting facets in the field of vibratory metal finishing are announced by Roto-Finish Ltd., who have been investigating this process as a development of their knowledge with rotary barrelling machines.

At a demonstration held recently at their Hemel Hempstead factory several machines incorporating this technique were shown, including a number of as-yet one-off machines.

The machines, ranging from 1 to 10 cu. ft., consist of a rubber-lined open steel tub freely mounted on four coil springs. Attached to the base of the tub is a vibrator motor operating at 1500 r.p.m. The rotary action of the motor induces a gentle circulation of the components and abrasive mass contained in the tub.

This technique was adopted after experiments with the alternative method of inducing vibrating movement by means of an eccentric shaft. This was discarded in favour of the motor, because of mechanical failures from weld stress and shaft fracture. Further, by using a motor attached to the tub the source of energy is located as near as possible to the working area and thus there is no wastage of power or unnecessary and undesirable transmission of vibrations through the machine frame.

TECHNICAL *and* INDUSTRIAL APPOINTMENTS

Mr. Edgar Crisp has been appointed general sales manager of **Aerostyle Ltd.,** of North Acton, London.

Mr. Crisp has been in the service of the company for 35 years, during which time he has spent a considerable time in the workshops, been an outside fitter and demonstrator, assistant foreman of the fitting shop, and was in charge of the London showrooms when the firm moved to its present factory. Upon his transfer to North Acton, he was put in charge of the incoming order department and despatch stores, and for the last six years has been handling sales of the whole range of equipment manufactured by the firm. In his new appointment he controls the activities of the firm's 14 representatives covering England, Scotland and Wales.

* * *

Mr. Charles B. de Than has been appointed European commercial representative for **M and T Chemicals A.G.** according to an announcement by the International Division of the parent company, **Metal and Thermit Corporation.**

Mr. de Than, who will be headquartered in Zug, Switzerland, will be responsible for contacts with European companies under licence to produce M and T inorganic and organometallic chemicals, organic coatings and electroplating chemicals. M and T licensees include M. L. Alkan Ltd. (Great Britain), Albright and Wilson Ltd. (Great Britain), Waldberg S.A. (France), Rhône-Poulenc S.A. (France), Erich Kiesow GmbH (Germany) and Th. Goldschmidt A.G. (Germany).

He will also handle direct European sales of M and T products produced in the United States which include, in addition to the preceding, minerals and welding electrodes.

* * *

Three changes are announced in boards of unit companies of the **Turner and Newall** group.

Mr. J. Waddell, executive director of Turner Brothers Asbestos Co. Ltd. and of Glass Fabrics Ltd., has been appointed managing director of each. He continues to be the executive director of J. W. Roberts Ltd.

Mr. E. R. Pochin, home sales director of Ferodo Ltd., has been appointed managing director of that company. Mr. M. H. Good, becomes home sales director of Ferodo Ltd. in place of Mr. E. R. Pochin.

The board of directors of **Melwood Thermoplastics Ltd.** of Harpenden has been re-constituted as follows: Mr. A. A. Barr (chairman); Mr. A. W. Meldrum (managing director); Mr. A. E. Chambers, Mr. A. G. T. Fryer, Mr. L. Colkett, and Mr. G. J. B. Williams (directors).

Mr. Barr also becomes chairman of **Tensile Products Ltd.** and Mr. L. Colkett, Mr. G. J. B. Williams and Mr. R. A. Sanders join the board of this company. Mr. A. W. Meldrum continues as managing director.

These moves follow the recent acquisition of the entire share capital of Tensile Products and 75 per cent of that of Melwood Thermoplastics by the Castrol Group of Companies.

* * *

The **Griffin and George Group of Companies,** announce the appointment of Mr. Dennis S. Beard Ph.D., A.Inst.P., A.R.C.S., B.Sc. to the board of Griffin and George (Sales) Ltd. as technical sales director.

Dr. Beard joined the Griffin and George Organization in 1960 from the Norwich City College where he had been a lecturer in Physics and Mathematics.

* * *

Dr. J. W. Menter, M.A., Sc.D., F.Inst.P., has been appointed director of the **Tube Investments Research Laboratory** at Hinxton Hall, near Cambridge. During seven years at Hinxton, Dr. Menter has been leading research teams studying the microstructure of metals and has promoted notable advances in the techniques of electron microscopy and X-ray microanalysis.

* * *

Hanson-Van Winkle-Munning Co., have appointed Mr. Frederick A. Pitschke as Sales manager, Electrochemical Machining Division. Mr. Pitschke will be responsible for developing markets and sales for the company's electrochemical machining process.

* * *

Three new appointments, increasing the number of their outside sales representatives to 14, have been made by **Aerostyle Ltd.,** of North Acton.

They are Mr. F. T. Houlan, who joined the firm in 1937, (East London, Essex and east coast); Mr. A. G. Synnuck (E.C. London, North Middlesex, Beds. and Herts); and Mr. J. Fulton; (N.W. London, West Middlesex, Bucks. and Oxfordshire).

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IRREGULAR

PAGINATION

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ANODIZED ALUMINIUM FOR T.V. CENTRE

THE front and rear walls of the 10-storey administration block at the Granada TV Centre, Manchester, are of curtain wall construction, and were supplied by Norstel and Templewood Hawksley Ltd., of Slough, Bucks. This building has been voted by architects one of the "top ten" post-war buildings in Manchester and is a striking addition to the city skyline.

Norstel and Templewood Hawksley Ltd. made the curtain wall to the special design of the architect, Ralph Tubbs, O.B.E., F.R.I.B.A.

The method of construction was as follows: *anodized aluminium vertical hollow mullions span from floor to floor and carry transoms on spigot castings*, thus providing a complete metal grid framework for the walls. The spaces within this grid are filled with horizontal lines of fixed and opening light windows with special spandrel panels beneath, which are made of vitreous-enamelled steel backed by Asbestolux sheets.

The two curtain walls, which reduced the building time considerably, cost £45,000 and are self-decorative. The anodized aluminium framework has a natural silver colour and surrounds the semi-gloss grey enamel finish of the spandrel panels. No further decoration is necessary. To comply with fire regulations a concrete backing wall was constructed behind the curtain wall on each floor.

The next stage of the development on this site is the construction of a further studio and dressing-room block and this is now well advanced. Special curtain walling is again being supplied by Norstel and Templewood Hawksley Ltd.

Aluminium Assists Spare Parts Distribution

LORRIES with aluminium-faced plywood bodies and light-weight collapsible aluminium containers manufactured by Light Alloy Construction Ltd., are used for the transportation of replacement parts by Renault Ltd. Weight of each container is about 330 lb., i.e. about half the weight of a comparable wooden case. The containers also have the advantage of the high corrosion resistance of aluminium. in this case HS 30 W strong alloy sheet.

NEW GOODYEAR OFFICE

THE Goodyear Tyre and Rubber Co. (Gt. Britain) Ltd., announce, as part of their Industrial Products Division decentralization programme, the opening of a new sales office in Manchester to handle this field. The new office address is 24 Broughton Street, Manchester, 8. Telephone Deansgate 7921.

Set up to handle the needs of their customers in the northern half of England and Wales, Scotland, Eire and Northern Ireland, the new office will be under the direction of Mr. L. G. Millington, Northern Division manager (Industrial Products), and Mr. J. L. Harris has been transferred from the Company's headquarters in Wolverhampton to control the sales office.

Waste Liquors Disposal Service

ASSOCIATED Chemical Companies Ltd., announce that they are able to extend the service recently introduced to users of chromic acid for the disposal of waste chrome plating liquors.

Users who are able to deliver to the Birmingham Works of A.C.C. (Brotherton) Ltd., can now dispose of waste chromic acid liquors of a much lower concentration. The minimum strength which can be accepted has been reduced from 25 to 15 per cent CrO_3 W/W and it is hoped that this extension to the service will benefit a much larger number of users of chromic acid.

NEW FILM ON TITANIUM OXIDE

THE film "Titanium Oxide by Laporte" has just been completed for Laporte Titanium Ltd., and had its initial showing in London this week.

Produced by The Film Producers' Guild (a Harold Goodwin production) "Titanium Oxide by Laporte" was scripted and directed by George Sewell and photographed, mainly at the Stallingborough factory and laboratories, by J. Jones.

The film begins by following a consignment of the raw material, ilmenite, from Norway on its journey and into the Laporte Titanium Ltd. factory. It then shows each stage of the transformation of this black mineral into white titanium oxide pigment.

The importance placed by Laporte upon process control, laboratory tests and customer service is impressively conveyed in the film.

"Colour is introduced," says the commentator, James McKechnie, as the Company's newest product, titanium nickel yellow, is shown and at this point the film changes to Eastman colour, concluding with a colourful montage of many of the products in which titanium oxide is used.

The film runs for 28 minutes and will be shown in all parts of the country to commercial and technical audiences from the paint, paper, plastics and other industries served by Laporte Titanium Ltd.

A still from the film, showing the inside of a rotary container at the Stallingborough factory.

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

Gold Reclamation

THE development of a new mecho-chemical device for reclaiming gold from electroplating solutions and rinses, available with integrated refining service, has been announced by Precious Metals Recovery Corp., an affiliate of Sel-Rex Corporation, Nutley, New Jersey. Trade-named Aurion-X Gold Resin Reclaim, the equipment is said to be a fluid handling station utilizing twin-connected, clear lucite columns "charged" with PM/79 resins.

Aurion-X is claimed to remove over 97 per cent. of the gold present in either alkaline or acid solutions in one pass — even from "open-end" cascade rinse systems. The PM/79 resins, which have a capacity of up to 30 troy oz., absorb gold previously impossible to recover because of only trace amounts found in rinsing systems.

When saturated, the lucite cartridges can be returned intact for processing as part of the reclaim-refine "package." Stand-by cartridges are said to be easily fitted to the Aurion-X avoiding any interruption in reclaim-processing while original chamber contents are being refined.

Literature giving details of the Gold Resin Reclaim and the "reclaim-refine" service is available from the manufacturer.

Spray Booth

ALFRED Bullows and Sons Ltd., Long Street, Walsall, announce the introduction of a new version of their Nopump spray booth (Fig. 1). This is a self-contained "packaged" unit which can be used virtually anywhere and it embodies all the advantages claimed for the Nopump design, *i.e.*, no circulating pump, filters, pipes or nozzles, complete reliability, infrequent maintenance, reduced space requirements etc.

The new booth is of monoform construction in 16 s.w.g. sheet metal and is 5 ft. wide, 4 ft. overall depth, and has a height of 9 ft. 2 in. to the fan. The standard bench type unit can be converted to full depth type quickly and easily by the use of a conversion kit.

A further advantage of this Nopump spray booth is that the power consumption is less than that of a conventional water wash spray booth of the same size. The fan is driven by a 3 h.p. motor and the extract rate is 3,500 cu. ft. per min. at $3\frac{1}{2}$ in. s.w.g.

Finish for Electrostatic Hand Guns

AN aluminium-based polychromatic paint which can be applied with any electrostatic hand gun is the latest addition to the range of Vulcan finishes manufactured by the Industrial Division of Blundell, Spence and Co. Ltd.

Until now it has been difficult to spray metallic paints with an electrostatic hand gun because of the rapid build-up of deposited metal in the paint feed line. This provided a path for the high voltage electrostatic charge to leak away to earth, preventing the system from operating.

The new paint, developed by Blundell Spence at their Slough laboratories, has overcome this problem. It is a one-coat finish, and can be either air-dried (30 minutes) or stoved (20 minutes at 240 to 250°F.). At present the new paint is available only in silver grey, which dries to a semi-gloss finish.

It is recommended for a variety of articles, including tubular steel furniture, agricultural and dairy equipment and domestic articles. It can also be applied by normal air spray and airless spray.

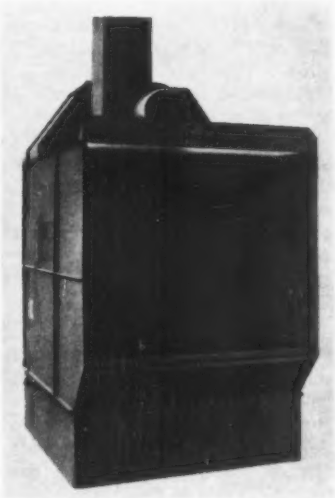


Fig. 1.
Spray booth

Silicone Rubbers

I.C.I. Nobel Division, Stevenston, Ayrshire, has added a further two products to its range of 'Silcoset' silicone rubbers. These rubbers, which cure at room temperature, were first introduced in 1960.

'Silcoset' 103 is a white solvent-free paste that cures at room temperature to a resilient silicone rubber after addition of the appropriate curing agent. This rubber, similar in properties to the pink 'Silcoset' 100, is recommended for high temperature sealing, patching, caulking, potting and the encapsulation of sensitive electronic assemblies. Dissolved in a solvent it can be sprayed, and cloth may be coated by spraying or dipping.

'Silcoset' 104 is thixotropic, with flow properties that make application from a caulking gun eminently satisfactory. 'Silcoset' 104, which can be readily bonded to primed metal surfaces, is especially suited for sealing, patching and caulking when a room temperature cure is necessary.

Four curing agents are available for these rubbers. 'Silcoset' curing agent "A" is a general purpose agent, "B" is comparatively slow acting and useful when long pot life is needed, "C" is a non-toxic agent, and "D" is very fast acting.

Spray Equipment

ALFRED Bullows and Sons Ltd., Long Street, Walsall, announce the introduction of a new spray gun and a completely new range of "FF" fine finishing nozzles for use with the Graco Airless Hydra-Spray equipment, for which they are sole U.K. distributors.

Designed to increase efficiency and reduce operator fatique, the spray gun is known as the Hydra-Spray "Golden" gun. It is a lightweight gun whose new rotary-action packing eliminates leaks. Very light trigger pressure gives an immediate, precise spray pattern and there is no "lag" to cause spitting.

The advantages claimed for "FF" nozzles are that fine finishes can be applied with feathered edges, thus enabling passes to be lapped; lower air pressure is required to operate the Hydra-Spray pressurizing pump, and finally, the nozzles can apply thinner coatings than have so far been possible. There are 17 "FF" nozzles, covering the complete range of fine finishing applications.

The gun is equally efficient for high volume fine finishing or protective coating work, and the single hose enters the gun handle for improved balance; furthermore, coupling of the hose to the gun is by a special swivel attachment which gives the operator more freedom with less fatigue. A further feature is that the gun incorporates a tungsten carbide fluid valve and seat.

Logarithmic Electronic Recorder

A BRITISH designed and made electronic strip chart recorder, with alternative logarithmic or linear response, is announced by Honeywell Controls Ltd., Greenford, Middlesex. It is intended mainly for research applications though the instrument will find industrial uses.

The recorder has two slidewires fitted in the standard position and the pen carriage is fitted with two sets of slidewire contacts. One slidewire is included in the measuring circuit and, to obey a logarithmic law, it is wound in twelve linear sections, each section having wire of different gauge or material. The law accuracy of the logarithmic slidewire is claimed to be better than 0.4 per cent.

The second slidewire is of linear construction and this is connected to a d.c. power pack from which a negative bias voltage is applied to the final voltage stage of the amplifier via the second set of slidewire contacts. Thus the magnitude of this bias voltage is relative to the pen carriage position and so provides automatic amplifier gain control to maintain stable operation over the full scale travel.

A two-position switch is incorporated in the measuring circuit to provide logarithmic or linear working. The new logarithmic/linear recorder has a calibration accuracy of better than 1 per cent. but to maintain a repeatable accuracy of 0.25 per cent over the full scale the minimum span is restricted to 5 mV.

Electronic Weighing

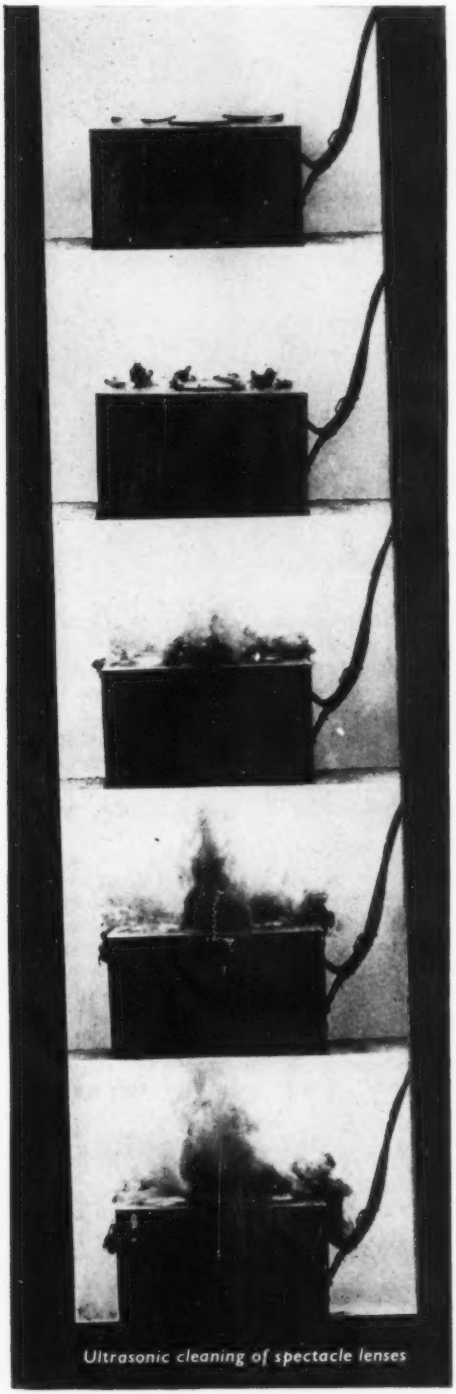
A NEW range of electronic weighing equipment is being introduced into Great Britain by Rotax Ltd., under a licence agreement with the leading manufacturer of this type of equipment in the U.S.A. A full engineering service is provided to cover design and installation of complete systems including instrumentation and associated steel structures.

Weight indication can be given on a visual dial indicator, a full numerical digit indicator or digital display. Weight recording can be given using a pen recorder or made digitally, with print-out on a ticket or tape. Combinations of these can be supplied and equipment can be provided to drive teletype and punch card accounting equipment.

Provision can be made to integrate the system into process control schemes. It is adaptable for use in batch weighing, tank and hopper weighing, crane weighing and weighbridge systems. One of its advantages is its robustness and ability to operate under severe conditions.

For further information contact Rotax Limited. (Process Control Group), Chase Road, London, N.W.10.

(*Continued in page* 434)



Ultrasonic cleaning of spectacle lenses

Ultrasonic Cleaning

cleans ultra-efficiently

HOW?

By introducing high frequency pressure waves in liquid cleaning media (alkaline or solvents), causing momentary tiny vacua, called cavitations. The effect is a mechanical scrubbing action on surfaces to be cleaned, removing all oily or solid contaminations like dirt, swarf or grease. The pressure waves are created by immersed nickel transducers, which oscillate at a frequency of 22 kilocycles, the source of which is a valve generator converting the mains current to high frequency current.

WHAT?

Ultrasonic cleaning is the most effective method of cleaning articles which are difficult to clean by ordinary methods. In particular, parts which are contaminated with solid soil, such as pieces of polishing cloth or polishing paste, swarf in fine holes, enclosed angles, ridges, ledges, hollows; parts with dirt deposits of long standing; parts having residues of hardening compound, etc.

WHERE?

Ultrasonic cleaning can be applied in any kind of conventional cleaning installation, such as alkaline cleaning tanks, Tridegreasers, etc., by simply immersing the nickel transducers in the cleaning liquid. Special equipment entirely adapted to particular applications of Ultrasonic cleaning, either hand operated or fully automatic, can be supplied.

FURTHER QUESTIONS . . . concerning Ultrasonic Cleaning, its capabilities and characteristics, are answered in our special leaflet. Please write for a copy.

From Roto-Finish come these other surface treatments:

Barrelling and Vibrafinishing for metal and plastics to deburr, descale, deflash, radius, surface blend, polish or lustre.
Atram phosphating processes.
Electropolishing.
Ultrasonic cleaning.
Mechanical cleaning.
Grisiron Alkaline cleaners.
Euron cleaner passivator.
Conversion and protective coatings.

Tell you more about any or all of them? We would be happy to if you write or telephone us.

Rely on

Roto-Finish

to provide the finishing touch

Mark Road, Hemel Hempstead, Herts.
Boxmoor 4600 (PBX)

For Holland:
N.V. Roto-Finish Mij., Rotterdamseweg 370A, Delft, Holland

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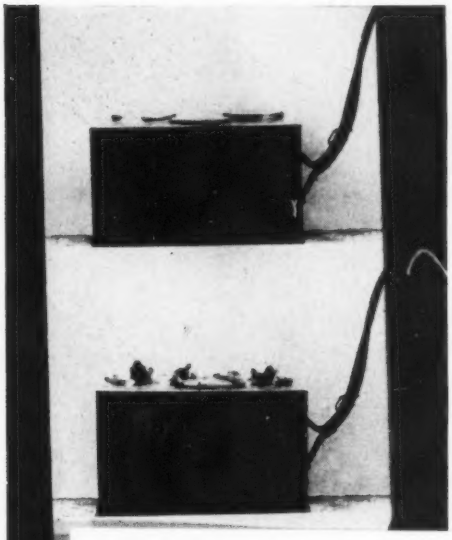
For further information contact Rotax Limited. (Process Control Group), Chase Road, London, N.W.10.

(*Continued in page* 434)



Ultrasonic Cleaning

cleans ultra-efficiently

HOW?

By introducing high frequency pressure waves in liquid cleaning media (alkaline or solvents) causing momentary tiny vacua, called cavitations. The effect is a mechanical scrubbing action on surfaces to be cleaned, removing all oily or solid contaminations like dirt, swarf or grease. The pressure waves are created by immersed nickel transducers, which oscillate at a frequency of 22 kilocycles, the source of which

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N.V. Roto-Finish Mij., Rotterdamseweg 370A, Delft, Holland

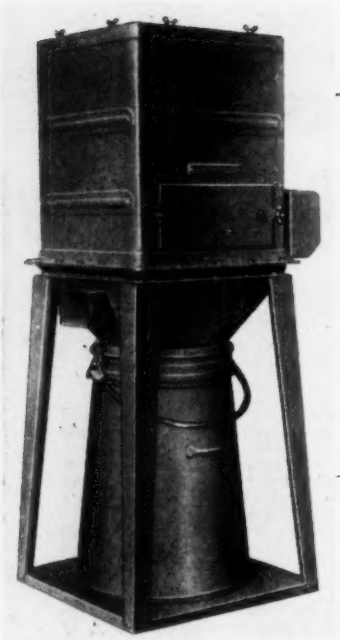

Fig. 2. (left)—Small dust filter

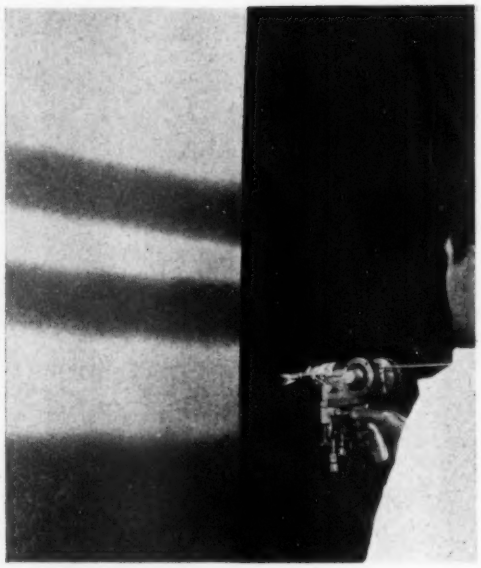

Fig. 3. (right)—Spreader nozzle

Small Dust Filters

IN modern methods of manufacture, blending, storing and mixing etc., and in the increase of pneumatic conveying of powder materials, there is also an increasing demand for neat, small and compact dust filter equipment for use as either a primary or a secondary filter, in cases where a fan or pump is already part of the main machinery.

A ready answer to this demand is the bin type adaptation of the Dallow Lambert " Unimaster " venting unit (Fig. 2) fitted with " pad " type fabric filter of either cotton, nylon or terylene giving 100 sq. ft. of filter area, together with motorized shaking gear and a 4 cu. ft. quick-release dust container. Full details available from Dallow Lambert and Co. Ltd., Thurmaston, Leicester.

Spreader Nozzle

THE use of metal spraying pistols having a high throughput of metal creates new problems in the spraying technique. Pistols now available are capable of spraying zinc at the rate of 60 lb. and more per hour, and aluminium at equivalent coverage rates. At such high delivery it is of great importance that the metal is applied with the utmost economy. For this reason Metallisation Ltd., Dudley, Worcs., have produced an auxiliary spreader nozzle for attachment to their Mark 33 metal spraying pistol. This special attachment will spread the spray stream from a 3/16 in. dia. wire to an effective width of 3 in. at normal spraying distance.

The makers say that in extended trials the nozzle has proved of considerable advantage when coating large surface areas. The use of high throughput pistols for spraying small or complicated shapes is not recommended since the most economical and effective metal spraying depends largely upon selection of the most suitable size of wire.

Modern pistols such as the Mark 33 are capable of using wires varying in diameter from 1 mm. to 3/16 in. so that the selection of wire demands only the change of a nozzle. An additional feature of the new spreader attachment is that it may be switched on and off independently of the pistol. This is effected by means of a small tap situated at the base of the pistol.

Fig. 3 shows the coating deposited by one sweep of the gun under normal conditions, compared below with a deposit applied by the spreader nozzle.

Corrosion Indicator for Boiler Water and Anti-Freeze

CALCO Rosolic Acid PF manufactured by the American Cyanamid Co. and of interest as an indicator for the corrosiveness of anti-freeze and boiler water, is now available from the U.K. distributors : D. G. Bennett Chemicals, 11a, St. John's Hill, London, S.W.11. Telephone : BATtersea 2242.

(*Continued in page* 436)

Fig. 4.—Flat lapping machine

Flat Lapping Machine

A NEW precision flat lapping machine (Fig. 4) produced by Engis Ltd., Gabriel's Hill, Maidstone, Kent, is 18 in. high by 11½ in. wide by 22 in. long and weighs 108 lb. It is driven by a ¼-h.p. electric motor running at 1420 r.p.m. The drive is transmitted through self-aligning couplings to a vertical spindle revolving in self-sealing ball races at 75 r.p.m.

Five interchangeable close-grained cast-iron lapping plates of the lift-off type, which have been hand scraped and then lapped with different grades of Hyprez diamond compound, can be supplied with each machine.

The machine is suitable for production runs of pump seals, valve seats, knife blades and other components which must be finished to a high degree of exactitude and flatness. It is already being used on the production of semi-conductor materials for experimental purposes. The plate revolution speed of only 75 r.p.m. allows the operator to hold the work by hand. Surface flatness down to one light band and surface finishes to one millionth of an inch (Centre Line Average) can be obtained in a matter of minutes, the makers claim.

Extra High-Purity Gold Electroplate for Electronic Applications

AN extra high purity gold electroplating process, TEMPEREX HD, is said to meet or surpass the most exacting finishing specifications required by manufacturers of transistors and other electronic components. Developed by Sel-Rex Corporation, Nutley, New Jersey, the new process is claimed to produce deposits of 99.99 per cent. purity, affording a uniformity of metallurgical characteristics never before attainable in gold electroplate.

Other advantages said to be offered by the electroplates include : hardness—75 Knoop, substantially greater than coatings produced from conventional or so-called " 24 Karat " cyanide formulations; remarkable ductility—electroforms can be cork-screw twisted without fracturing, important to the function and reliability of crimp-type connectors; exceptional machineability — no foreign codeposits to pit out during machining, important in slip rings and other applications where machining is performed subsequent to plating ; easy soldering or welding — as necessary in the bonding of silicon directly to gold plate.

According to Sel-Rex, there appears to be no practical limitation of thickness — *electroforms* to 30-thousandths of an inch are easily produced under commercial operating conditions. TEMPEREX HD electroplate is also reported to exceed the requirements of such standard electronic product acceptance tests as exposure to 550°C./10 minutes ; 300°C./96 hours in air.

Paint Stripper

A POWERFUL cold immersion paint stripper that will quickly remove the most adherent paint films, including stoved epoxy resin acrylic, alkyd amino and polyurethene enamels by immersion and merely hosing, plunge rinsing or brushing off, has been developed by Grant and West Ltd., Guildford, Surrey.

Called " Chemiclene " No. 415, the stripper can be used in an ordinary mild-steel tank and is supplied with its own inhibited, anti-corrosive water seal to prevent evaporation.

This product is claimed to be much safer to use than many paint strippers but because it contains strong solvents and is mildly acidic, operators should wear protective clothing and eye and face shields as a protection against accidental splashing.

Components to be treated must be submerged completely below the sealing layer and should be withdrawn slowly to effect drainage and thereby reduce drag-out loss of the solvents before passing through the water seal. The water seal should be maintained at one-tenth of the total depth of liquid in the tank and can be topped up by the addition of clean, cold water to which is added the No. 415 inhibitor — one pint to every 10 gall. of water used.

It is recommended that a wire-mesh sludge tray be used to facilitate the removal of the paint film.

A grade of the stripper is available which does not leave a residual smell on the metal treated.

(*Continued in Advert. p.* 34)

Plant, Processes and Equipment

(*Continued from page 436*

Polishing Compound

ROTO-FINISH Ltd., Mark Road, Hemel Hempstead, Herts, announce the introduction of "Universal White" polishing compound. This compound has been especially developed to provide a white polishing composition with a universal application for polishing prior to decorative plating or for final lustre finishing, and can be used on most metals.

The compound has been prepared to withstand any powderization. The abrasive media contained is of extremely fine grade with a strong and consistent coating power. Therefore, small quantities only should be applied to the mop, and a fast lustre can be produced with extremely fine micro finish. In actual application it has been proved to be three times more economical than conventional finishing compounds when used on nickel, copper, brass and stainless steel.

A further advantage claimed for nickel finishing is that it does not contain a binding grease of orthodox type, but incorporates a special binding compound which is easily soluble and considerably facilitates subsequent cleaning.

Vinyl Coating

SWALE Chemicals Ltd., 53, Park Hill Road, Croydon, Surrey, have developed an easily strippable protective vinyl coating Type KP/100 for metal and glass. The material can be applied by brushing, spraying, dipping or flow coating. Used primarily to protect the surface of polished metal or plate glass, KP/100 is also suitable as a substitute for strippable tapes in painting and building construction.

Tough enough to withstand abrasion, KP/100 is highly flexible and can be stripped off as a continuous film. It is claimed to be resistant to moisture, common solvents, acids and alkali, oil, detergents, plaster and mortar. Due to its high film strength, it is very economical in use.

Disposable Wipers in Roll Form

KIMWIPES, the disposable wipers made by Kimberly-Clarke Ltd., Larkfield, Maidstone, Kent, are now available in roll form. The new Kimwipe roll, which is made of 2-ply soft, strong cellulose, is specially designed for heavier cleaning jobs, involving oils, grease, dirt and solvents.

The roll is made up of 100 20 in. x 18 in. (approx.) sheets. Perforations enable each sheet to be torn off evenly.

Classified Advertisements

Prepaid rates: FIFTEEN WORDS for 7s 6d. (minimum charge) and 4d. per word thereafter, or 24s. per inch. Box number 2s. 6d. including postage of replies.

SITUATIONS VACANT

Messrs. W. Canning & Co. Ltd. are constructing a large Architectural Anodising Plant in the North of England. A qualified Engineer will be required to take charge of the installation. It would be an advantage if the applicant had previous experience in anodising, otherwise he should have a working knowledge of Chemistry, Metallurgy, Metal Finishing Techniques, Plant Installation and Supervision. This is a permanent progressive post, with an attractive salary. Applicant would be required to join contributory pension and life insurance scheme. Applications in writing to Box MC 246.

SITUATIONS VACANT—contd.

HOOVER
(WASHING MACHINES)
LIMITED

of Merthyr Tydfil

have a vacancy for a

METAL FINISHING SUPERINTENDENT

The successful applicant's duties will include the supervision of a large Electrostatic Enamel installation consisting of three plants using the Ransberg No. 2 process, together with associated pre-treatment plants.

In addition he will be expected to take charge of a high capacity Porcelain Enamel Plant employing continuous furnaces and up to date methods of application.

The ideal man should be between 35 and 45, hold suitable qualifications in Industrial Chemistry and have experience in running large Metal Finishing Plants.

This post carries an attractive remuneration and the Company has a generous Pension Scheme. Assistance will be given in obtaining accommodation if required.

This factory which is the largest of its kind in Europe, is situated near the Brecon Beacons National Park and also within easy reach of the Gower Coast.

Letters of application will be dealt with in complete confidence and should be sent to the Employment Officer giving full details of age, qualifications and experience.

Interviews arranged on a Saturday morning if necessary.

Any further information can be obtained by telephoning Merthyr Tydfil 3221, extension 50.

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or
ELECTROCHEMISTS

Olin Mathieson Chemical Corporation require for their modern well-equipped Metallurgical Laboratories in New Haven, Connecticut, U.S.A.:

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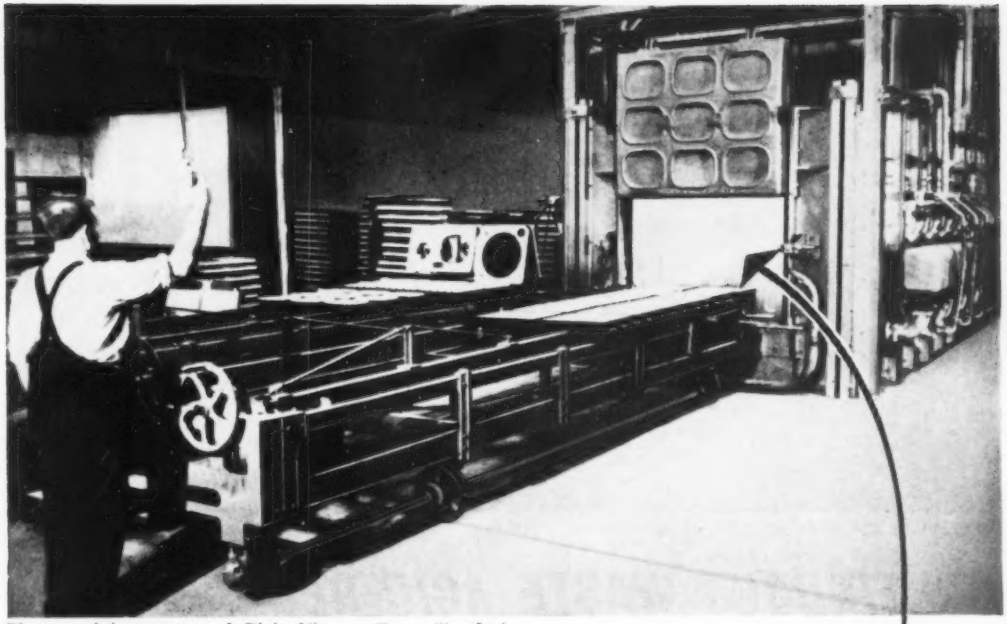
Managing Director, Olin Mathieson Ltd., 17/18, Old Bond Street, London, W.1



Photograph by courtesy of: Blake Vitreous Enamelling Ltd.

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Built to do the highest quality finishing, painting and refinishing —with all kinds of materials * Gives finer atomization, higher speed and is longer lasting than any other spray gun * Reinforced at points of wear—for years of service * More than enough air and fluid capacities to meet any production demand * Complete range of air caps and fluid tips.

Ask for details also of the gravity feed and the many smaller and special purpose guns in the Aerograph-DeVilbiss range.

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